EE/CA and RI/FS Support Sampling Plan

Sauget Area 1

Sauget and Cahokia, Illinois

Volume 1A

Support Sampling Plan

June 25, 1999

Submitted To:

U.S. Environmental Protection Agency
Chicago, Illinois

Submitted By:

Solutia Inc.
St. Louis, Missouri

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Sauget and Cahokia, Illinois

Volume 2 - Appendix A

Soil, Groundwater, Surface Water, Sediment and Air FSP, QAPP and HASP

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10040/23548

Soil, Ground Water, Surface Water, Sediment, and Air Sampling
FIELD SAMPLING PLAN

Sauget Area 1 Support Sampling Plan
Sauget and Cahokia, Illinois
Volume 2A

Remediation Technology Group
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June 1999

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1. Project background

This Field Sampling Plan (FSP) has been prepared by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) on behalf of Solutia Inc. (Solutia) as part of the Support Sampling Plan at the Sauget Area 1 Site (the site) located along Dead Creek in the villages of Sauget and Cahokia, Illinois. This FSP details the activities to implement the Support Sampling Plan for field sampling, sample handling and storage, chain of custody, and field analysis efforts associated with sampling of environmental media at the Sauget Area 1 Site and is one component of the Engineering Evaluation/Cost Assessment (EE/CA) and Remedial Investigation/Feasibility Study (RI/FS) Support Sampling Plan (SSP).

The purpose of this SSP is to gather sufficient information from the Sauget Area 1 Site to identify the nature of waste materials in Sites G, H, I, L, M, and N and to assess the extent of constituent migration in soil, ground water, surface water, sediments, and air at the site. Figure 1 is a plan of the site.

The site description is presented in Section III of the Administrative Order by Consent (AOC) (USEPA, 1999) and in the Ecology and Environment, Inc. data report (Ecology and Environment Data Report) (Ecology and Environment, Inc., 1998). The source areas are designated as Sites G, H, I, L, M, and N, and Dead Creek Segments (CS) CS-A, CS-B, CS-C, CS-D, CS-E, and CS-F in the AOC and Data Report.

The activities described in this FSP will be performed in accordance with O'Brien & Gere's Health & Safety Plan (HASP) dated April 1999 and O'Brien & Gere's Quality Assurance Project Plan (QAPP) dated April 1999.

1.1. Site history, summary of existing site data, and problem definition

1.1.1. Site background

Sauget Area 1 is located in the villages of Sauget and Cahokia, St. Clair County, Illinois. The study area is centered on Dead Creek, an intermittent stream that is approximately 17,000 feet long, and its floodplain. The study area includes three closed municipal/industrial landfills (Sites G, H, and I), one backfilled wastewater impoundment (Site L), one flooded borrow pit (Site M), and one backfilled borrow pit (Site N). The study area also includes six creek segments:

Creek Segment A	Alton & Southern Railroad to Queeny Avenue
Creek Segment B	Queeny Avenue to Judith Lane
Creek Segment C	Judith Lane to Cahokia Street
Creek Segment D	Cahokia Street to Jerome Lane
Creek Segment E	Jerome Lane to Route 157
Creek Segment F	Route 157 to Old Prairie du Pont Creek

These sites and creek segments are shown on Figure 1.

1.1.2. Land use

During recent years, land use has been consisent in the area surrounding Dead Creek. In a 1988 report prepared for the Illinois Environmental Protection Agency (IEPA) (Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois), Ecology and Environment indicated that "A wide variety of land utilization is present [in the study area]. The primary land use in the town [village] of Sauget is industrial, with over 50% of the land used for this purpose. Small residential, commercial, and agricultural properties are also interspersed throughout the town [village]. Significant land use features, in relation to individual project sites will be discussed below.

Land surrounding the Area 1 project sites is used for several purposes. A small residential area is located immediately east of Sites H and I, across Falling Springs Road. The nearest residence is approximately 200 feet from these sites. The Sauget Village Hall is also located on top of, or adjacent to, Site I .... South of Sites G and L are two small cultivated fields which are used for soybean production. These fields separate the sites from a residential area in the northern portion of Cahokia. Several small commercial properties are also found in the immediate vicinity of the Area 1 sites." These land use patterns are typical of Dead Creek east of its intersection with Route 3 (Mississippi Avenue). Immediately south of Route 3 there is a residential area. After this developed area, Dead Creek runs through undeveloped area until it reaches the lift station at Old Prairie du Pont Creek.

1.1.3. Climate

Geraghty and Miller, in a report prepared for Monsanto (Site Investigation for Dead Creek Segment B and Sites L and M, Sauget-Cahokia, Illinois, 1992), indicates that "The climate of the site(s) is continental with hot, humid summers and mild winters. Periods of extreme cold are short. The average annual rainfall in the area for the period from 1903 to 1983 was 35.4 inches; however, precipitation increased to 39.5 inches per year during the period between 1963 and 1988. The average annual temperature is 56°F; the highest average monthly temperature (79 °F) occurs in July and the lowest average monthly temperature (32 °F) occurs in January."

1.1.4. Hydrology

According to Ecology and Environment (1988), "the project area lies in the floodplain, or valley bottom, of the Mississippi River in an area known as the American Bottoms. For the most part, the topography consists of nearly flat bottom land, although many irregularities exist locally across the site areas.... Generally, the land surface in undisturbed areas slopes from north to south, and from the east toward the river. This trend is not followed in the immediately vicinity of [Sauget Area 1]. Elevations of Area 1 sites range from 410 to 400 ft above mean sea level (MSL) ... Little topographic relief is exhibited across individual sites, with the exception of Site G ...

Surface drainage in the project area is typically toward ... Dead Creek. However, significant site-specific drainage patterns are present. A brief description of surface drainage for individual sites is given below.

Site G - Drainage at Site G is generally east toward CS-B. A large depression exists in the south-central portion of the site. Surface runoff flows toward the depression [Note: As a result of an emergency response action by USEPA

Region V in 1995, Site G is capped and surface water flow is directed radially away from the site].

Site H - Drainage at Site H is typically to the west toward CS-B. Several small depressions capable of retaining rainwater, are scattered across the site. Precipitation is these areas infiltrates the ground surface rather than draining from the site.

Site I - Drainage is generally to the west toward the two holding ponds which make up CS-A. [Note: Creek Segment A was closed under an IEPA-approved plan in 1990/91. Impacted sediments were removed and transported off-site for disposal, a high-density polyethylene (HDPE) membrane vapor barrier was installed, a storm water retention basin was constructed, and the site was backfilled to create a controlled-access truck parking lot. Water that used to be impounded in CS-A is now drained to the new storm water retention basin.] CS-A also receives surface and roof drainage from the entire Cerro plant area located west of CS-A. This drainage flows through a series of storm sewers and effluent pipes. A large depression exists in the northern portion of Site I [Note: This depression no longer exists]. Precipitation in this area flows toward the depression.

Site L - Site L is a former subsurface impoundment which has subsequently been covered with highly permeable material (cinders). Runoff from the surface, although inhibited by the permeable nature of the cinders, flows toward CS-B.

Site M - Site M receives surface runoff from a small residential area located east and south of the site. Water in Site M eventually drains into CS-B through a cut-through located in the southwest corner of the site.

Site N - Because the excavation which constitutes Site N [is] only partially filled, it receives runoff from the surrounding area. The creek bank in this area (CS-B) [CS-C] is approximately ten feet higher that the lowest point in the excavation.

Dead Creek - Dead Creek serves as a surface water conduit for much of the Sauget and Cahokia area. The creek runs south and southwest through these towns [villages] to an outlet point in the [O]ld Prairie Du Pont [sic] Creek floodway, located south of Cahokia. The floodway in turn discharges to the Cahokia Chute of the Mississippi River. ... Creek Segment A is isolated from the remainder of Dead Creek because the culvert under Queeny Avenue has been blocked with concrete. CS-A drains to an interceptor at the north end of the Cerro property. Water from this interceptor is carried to the Sauget Waste Water Treatment Plant. The culvert is partially blocked a the south end of CS-B, and flow from this Segment to the remainder of the creek is restricted. Although the degree of this restriction has not been evaluated, it is known that water does not usually flow through this culvert."

1.1.5. Geology

Geraghty and Miller (1992) described site geology as follows: "The site(s) is situated on the floodplain of the Mississippi River. The floodplain is locally named the American Bottoms and contains unconsolidated valley fill deposits composed of recent alluvium (Cahokia Alluvium), which overlies glacial material (Henry Formation). Published information indicates that these unconsolidated deposits are underlain by bedrock of Pennsylvanian and Mississippian age consisting of limestone and dolomite with lesser amounts of sandstone and shale.

The Cahokia Alluvium (recent deposits) consists of unconsolidated, poorly sorted, fine-grained materials with some local sand and clay lenses. These recent alluvium deposits unconformably overlie the Henry Formation which is Wisconsinian glacial outwash in the form of valley train deposits. The Henry Formation is about 100 feet thick. These valley-train materials are generally medium to course sand and gravel and increase in grain size with depth."

1.1.6. Water resources

Domestic water supply. Ecology and Environment (1988) conducted an evaluation of ground water and surface water resources and the results of this evaluation are summarized below.

"The primary source of drinking water for area residents is an intake in the Mississippi River. This intake is located at river mile 181, approximately 3 miles north of the DCP [Dead Creek Project] study area. The drinking water intake is owned and operated by the Illinois American Water Company (IAWC) of East St. Louis, and it serves the majority of residences in the DCP area. IAWC supplies water to ... Sauget .... The Commonfields of Cahokia Public Water District purchases water from IAWC and distributes it to portions of Cahokia and Centerville Township. The Cahokia Water

Department also purchases water from IAWC and distributes it to small residential areas in the west and southwest portions of Cahokia.

A review of IDPH and ISGS files indicated that at least 50 area residences [within a 3 mile radius of the site] have wells which are used for drinking water or irrigation purposes. These wells are located in Cahokia (23) ....The nearest private wells to any of the DCP sites are located on Judith Lane, immediately south of the Area 1 sites. Based on interviews with these well owners, only one of the five wells located in this area is used occasionally as a source of drinking water and the other four are never used for this purpose.

In summary, although the majority of residences in the general project area are serviced by public water supply systems, well over 50 homes [within a 3 mile radius of the site] utilize private well supplies for drinking water or irrigation purposes."

Industrial water supply. Ecology and Environment (1988) also described industrial water usage. "Industrial groundwater usage has been very extensive in the past. Peak use occurred in 1962 when groundwater pumpage exceeded 35 million gallons per day (mgd). Relatively few industries utilize well-supplied groundwater for process or cooling water. Total groundwater pumpage from industrial sources in the project area [3 mile radius] is estimated to be less than 0.5 mgd." [Note: Ground water usage is probably even lower today given the decline in the regions industrial base.]

Downstream surface water intakes. Ecology and Environment (1988) indicated that "the nearest downstream surface [water] intake on the Illinois side of the Mississippi River is located at river mile 110, approximately 64 miles south of the project area. This intake supplies drinking water to residents in the Town of Chester and surrounding areas in Randolf County, Illinois. The nearest potentially impacted public water supply on the Missouri side of the river is located at river mile 149, approximately 28 miles south of the DCP area. The Village of Crystal City, Missouri (pop. 4,000) located 28 miles south of the DCP area, utilizes a Ranney well adjacent to the Mississippi River as a source for drinking water. Although this is not actually a surface water intake, it is assumed that the well draws water from the river due to its construction and location adjacent to the river."

Agricultural water supply. Ecology and Environment (1988) reported that "Although agricultural land is found throughout the immediate project area, this land is apparently not irrigated. The nearest irrigated land, other than residential lawns and gardens, is located in the Schmids Lake-East Carondelet area [south of Old Prairie du Pont Creek which is the end of Sauget Area 1]."

1.1.7. Existing fill area information

USEPA Region V, IEPA, Monsanto/Solutia and Cerro Copper have collected a considerable amount of information on soil, ground water, surface water, and sediment in Sauget Area 1. Information included in the January 19, 1999 AOC is given verbatim below. The location of Sites G, H, I, L, M, and N and Creek Segments B, C, D, E, and F are shown on Figure 1.

Site G. "Located south of Queeny Avenue, east of (and possibly under) the Wiese Engineering facility, and north of a cultivated field in the Village of Sauget. CS-B of Dead Creek is located along the eastern boundary of the Site. This site is approximately 5 acres in size and it was operated and served as a disposal area from approximately 1952 to the late 1980's. The Site was fenced in 1988 pursuant to a U.S. EPA removal action under CERCLA which was funded by potentially responsible parties, including Monsanto. On information and belief, wastes located on the surface and/or in the subsurface of Site G have spontaneously combusted and/or burned for long periods of time on several occasions. U.S. EPA conducted a second CERCLA removal action at Site G in 1995. This removal action involved the excavation of PCB, organics, metals, and dioxin contaminated soils on and surrounding Site G, solidification of open oil pits on the Site, and covering part of the Site (including the excavated contaminated soils) with a clean soil cap approximately 18 to 24 inches thick. Site G is enclosed by a fence and is not currently being used. The property is vegetated.

Site G operated as a landfill from approximately 1952 to 1966. The site was subject to intermittent dumping thereafter until 1988, when the Site was fenced. There is an estimated 60,000 cubic yards of wastes within Site G, including oil pits, drums containing wastes, paper wastes, documents and lab equipment. Soil samples collected from Site G revealed elevated levels of VOCs such as chloroform (11,628 ppb), benzene (45,349 ppb), tetrachloroethene (58,571 ppb), chlorobenzene (538,462 ppb), and total xylenes (41,538 ppb). Soil samples also revealed elevated levels of semi-volatile organic compounds (SVOCs) such as phenol (177,800 ppb), naphthalene (5,428,571 ppb), 2,4,6-trichlorophenol (49,530 ppb), and pentachlorophenol (4,769,231 ppb). Elevated levels of the pesticide 4,4-DDE were detected up to 135,385 ppb. Elevated levels of PCBs were detected at levels as high as 174,419 ppb (Aroclor 1248) and 5,300,000 ppb (Aroclor

1260). Dioxin levels in soils at Site G were detected at levels as high as 44,974 ppb. Metals were detected at elevated concentrations such as arsenic (123 ppm), barium (45,949 ppm), copper (2,215 ppm), lead (3,123 ppm), mercury (34.3 ppm), nickel (399 ppm), and zinc (4,257 ppm). Samples collected from wastes which appeared to be a pure solid product material on Site G revealed PCB levels as high as 3,000,000 ppb and dioxin levels in excess of 50,661 ppb.

Groundwater samples collected from beneath Site G revealed elevated levels of VOCs such as trans-1,2-dichloroethene (200 ppb), 1,2-dichloroethane (480 ppb), trichloroethene (800 ppb), benzene (4,100 ppb), tetrachloroethene -L420 ppb), toluene (7,300 ppb), and ethyl benzene (840 ppb). Elevated levels of SVOCs were detected such as 1,2,4-trichlorobenzene (1,900 ppb), naphthalene (21,000 ppb), 4-chloroaniline (15,000 ppb), and 2,4,6-trichlorophenol (350 ppb). An elevated concentration of PCBs was detected at 890 ppb (Aroclor 1260). Elevated metals in groundwater beneath Site G included arsenic (179 ppb), mercury (2.1 ppb), nickel (349 ppb), zinc (1,910 ppb) and cyanide (350 ppb)."

Site H. "Located south of Queeny Avenue, west of Falling Springs Road and west of the Metro Construction Company property in the Village of Sauget, it occupies approximately 5 to 7 acres of land. The southern boundary of Site H is not known with certainty but it is estimated that the fill area extends approximately 1,250 feet south of Queeny Avenue. Site H is connected to Site I under Queeny Avenue and together they were known to be part of the Sauget-Monsanto Landfill [Note: Sauget used to be known as Monsanto until the name of the village was changed] which operated from approximately 1931 to 1957. Site H is not currently being used and the property is graded and grass-covered with some areas of exposed slag.

Due to the physical connection to Site I, waste disposal at Site H was similar to that at Site I. Chemical wastes were disposed of here from approximately 1931 to 1957. Wastes included drums of solvents, other organics and inorganics, including PCBs, para-nitro-aniline, chlorine, phosphorous pentasulfide, and hydrofluosilic acid. Municipal wastes were also reportedly disposed of at Site H. The estimated volume of wastes in Site H is 110,000 cubic yards. There is no containment beneath Site H. Soil samples collected at Site H revealed elevated levels of VOCs such as benzene (61,290 ppb), tetrachloroethene (5,645 ppb), toluene (76,450 ppb), chlorobenzene (451,613 ppb), ethyl benzene (12,788 ppb), and total xylenes (23,630 ppb). Elevated levels of SVOCs were also found in soil samples such as 1,4-dichlorobenzene (30,645,161 ppb), 1,2 dichlorobenzene (19,354,839 ppb), 1,2,4-trichlorobenzene (7,580,645 ppb), 4-nitroaniline (1,834,000 ppb), phenanthrene (2,114,000 ppb), and fluoranthene (1,330,000 ppb). Soil samples also revealed elevated levels of PCBs such as Aroclor 1260 (18,000,000 ppb), and pesticides 4,4-DDE (780 ppb), 4,4-DDD (431 ppb), and 4,4-DDT (923 ppb). Elevated levels of metals were found such as arsenic (388 ppm), cadmium (294 ppm), copper (2,444 ppm), lead (4,500 ppm), manganese (36,543 ppm), mercury (3.9 ppm), nickel (15,097 ppm), silver (44 ppm), and zinc (39,516 ppm).

Groundwater samples collected from beneath Site H revealed elevated levels of VOCs such as chloroform (3,000 ppb), benzene (4,300 ppb), and toluene (7,300 ppb). Elevated levels of SVOCs were detected in groundwater such as phenol (950 ppb) and pentachlorophenol (650 ppb). An elevated level of PCBs (Aroclor 1260 at 52 ppb) was also detected in groundwater at Site H. Elevated levels of metals were also detected in groundwater such as arsenic (8,490 ppb), copper (2,410 ppb), nickel (17,200 ppb) and cyanide (480 ppb)."

Site I. "Located north of Queeny Avenue, west of Falling Springs Road and south of the Alton & Southern Railroad in the Village of Sauget it occupies approximately 19 acres of land. Segment CS-A of Dead Creek borders Site I on the Site's western side. The site is currently graded and covered with crushed stone and used for equipment and truck parking. Site I was originally used as a sand and gravel pit which received industrial and municipal wastes. Site I is connected to Site H (see below) under Queeny Avenue and together they were known to be part of the "Sauget-Monsanto Landfill." The landfill operated from approximately 1931 to 1957. On information and belief, wastes from Site I leached and/or were released into CS-A and available downstream creek segments until CS-A was remediated in 1990. [Note: The culvert between Creek Segment A and Creek Segment B was blocked in the 1970s.] On information and belief, Site I served as a disposal area for contaminated sediments from historic dredgings of Dead Creek Segment A.

On information and belief, this site accepted chemical wastes from approximately 1931 to the late 1950's. Municipal wastes were also disposed of in Site I. Site I contains approximately 250,000 cubic yards of contaminated wastes and fill material. No subsurface containment is in place beneath Site I. Soil samples collected from Site I have revealed elevated levels of volatile organic compounds (VOCs) such as 1,1,1-trichloroethane (1,692 ppb), trichloroethene (3,810 ppb), benzene (24,130 ppb), tetrachloroethene (5,265 ppb), toluene (77,910 ppb), chlorobenzene (126,900 ppb), ethyl benzene (15,070 ppb), and total xylenes (19,180 ppb). Soil samples also revealed elevated levels of SVOCs such as 1,3-dichlorobenzene (70,140 ppb), 1,4 dichlorobenzene (1,837,000 ppb), 1,2-dichlorobenzene (324,000 ppb), naphthalene (514,500 ppb), and hexachlorobenzene (1,270,000 ppb). Soil samples also revealed elevated levels of polychlorinated biphenyls (PCBs), such as Aroclor 1260 (342,900 ppb), and the pesticides 4,4-DDD (29,694 ppb), 4,4-DDT (4,305 ppb) and toxaphene (492,800 ppb). Elevated levels of metals were also found in soils, such as beryllium (1,530 ppm), copper (630 ppm), lead (23,333 ppm), zinc (6,329 ppm) and cyanide (3,183 ppm).

Groundwater samples collected from beneath Site I have revealed elevated levels of VOCs such as vinyl chloride (790 ppb), trichloroethene (279 ppb), benzene (1,400 ppb), tetrachloroethene (470 ppb), toluene (740 ppb), and chlorobenzene (3,100 ppb). Elevated levels of SVOCs were also detected in groundwater, such as phenol (1,800 ppb), bis-(2-chloroethoxy)methane (2,900 ppb), 1, 2, 4-trichlorobenzene (2,700 ppb), 4-chloroaniline (9,600 ppb), and pentachlorophenol (2,400 ppb)."

Site L. "Located immediately east of Dead Creek CS-B and south of the Metro Construction Company property in the Village of Sauget. Site L is the former location of two surface impoundments used from approximately 1971 to 1981 for the disposal of wash water from truck cleaning operations. This site is now covered by black cinders and is used for equipment storage. On information and belief, Site L wastes have migrated into Site M (see below).

This site was originally used as a disposal impoundment from approximately 1971 to 1981. The volume of contaminated fill material in Site L is not known, however, the area of the impoundment is estimated to be 7,600 square feet. There is no known containment of wastes beneath Site L. Soil samples collected at Site L revealed elevated levels of VOCs such as chloroform (20,253 ppb), benzene (4,177 ppb), and toluene (26,582 ppb). Elevated levels of SVOCs were also detected such as 2-chlorophenol (2,152 ppb), pentachlorophenol (58,228 ppb), and di-n-butyl phthalate (2,784 ppb). Total PCBs were found at a level of 500 ppm in soils. Elevated levels of metals were detected such as antimony (32 ppm), arsenic (172 ppm), and nickel (2,392 ppm).

Groundwater samples collected from beneath Site L revealed elevated levels of VOCs such as chloroform (730 ppb) and benzene (150 ppb). SVOCs were also detected in groundwater such as phenol (150 ppb), 2-chlorophenol (130 ppb)., 4-methyl phenol (75 ppb), 2-nitrophenol (41 ppb), and 4-chloroaniline

(60 ppb). Elevated levels of metals in groundwater included arsenic (14,000 ppb), cadmium (32 ppb) and zinc (2,210 ppb)."

Site M. "Located along the eastern side of Dead Creek CS-B (south of Site L) at the western end of Walnut Street in the Village of Cahokia. Site M was originally used as a sand borrow pit (dimensions = 220 feet by 320 feet) in the mid to late 1940's. The pit is hydrologically connected to Dead Creek through an eight-foot opening at the southwest portion of the pit. On information and belief, wastes from CS-B have in the past and potentially continue to migrate into Site M via this connection. The site is currently fenced.

Site M was originally constructed as a sand borrow pit in the mid to late 1940's. This pit is approximately 59,200 square feet in size and previous investigations indicate that approximately 3,600 cubic yards of contaminated sediments are contained within the pit. It is estimated that the pit is approximately 14 feet deep and it is probable that there is a hydraulic connection between this pit water and the underlying groundwater. Surface water samples collected from Site M revealed elevated levels of VOCs such as chloroform (27 ppb), toluene (19 ppb) and chlorobenzene (33 ppb). SVOCs detected in surface water included phenol (28 ppb), 2-chlorophenol (14 ppb), 2,4-dimethyl phenol (13 ppb), 2,4-dichlorophenol (150 ppb), and pentachlorophenol (120 ppb). Pesticides detected in surface water include dieldrin (0.18 ppb), endosulfan II (.06 ppb), 4,4-DDT (0.24 ppb), 2,4-D (47 ppb) and 2,4,5-TP (Silvex) (3.4 ppb). PCBs were also detected in surface water at a maximum level of 0.0044 ppb

Sediment samples collected from Site M revealed elevated levels of VOCs such as 2-butanone (14,000 ppb), chlorobenzene (10 ppb) and ethyl benzene (0.82 ppb). SVOCs detected in sediments included 1,4-dichlorobenzene (40 ppm), 1,2-dichlorobenzene (26 ppm), 1,2,4-trichlorobenzene (14 ppm), pyrene (27 ppm), fluoranthene (21 ppm), chrysene (12 ppm), and benzo(b)fluoranthene (15 ppm). Total PCB levels were detected as high as 1,100 ppm. Elevated levels of metals were also detected in sediments at Site M, including antimony (41.2 ppm), barium (9,060 ppm), cadmium (47.2 ppm), copper (21,000 ppm), nickel (2,490 ppm), silver (26 ppm), zinc (31,600 ppm), lead (1,910 ppm), arsenic (94 ppm) and cyanide (1.3 ppm)."

Site N. "Located along the eastern side of Dead Creek CS-C, south of Judith Lane and north of Cahokia Street in the Village of Cahokia. This Site encompasses approximately 4 to 5 acres of previously excavated land used to dispose of concrete rubble and demolition debris. The excavation began in the 1940's and the site is currently inactive and fenced.

Initially developed as a borrow pit in the 1940's, this Site has been filled with concrete rubble, scrap wood and other demolition debris. The depth of the fill may be as much as 30 feet and it occupies approximately 4 to 5 acres of land. Soil samples collected from Site N revealed the presence of SVOCs such as phenanthrene (434 ppb), fluoranthene (684 ppb), and pyrene (553 ppb). An elevated level of mercury (9 ppm) was also detected in soil at Site N."

1.1.8. Existing Dead Creek information

"Dead Creek stretches from the Alton & Southern Railroad at its northern end and flows south through Sauget and Cahokia for approximately 3.5 miles before emptying into the Old Prairie du Pont Creek, which flows approximately 2,000 feet west into a branch of the Mississippi River known as the Cahokia Chute. For many years, Dead Creek has been a repository for local area wastes. On December 21, 1928, an easement agreement between local property owners and representatives of local business, municipal and property interests was executed to "improve the drainage in that District (Dead Creek) by improving Dead Creek so as to make it suitable for the disposal of wastewater, industrial waste, seepage and storm water." Thereafter, Dead Creek systematically received direct and indirect discharges from local businesses and from the Village for many years to come.

Creek Segment CS-A is the northernmost segment of the creek. It is approximately 1800 feet long and 100 feet wide, running from the Alton & Southern Railroad to Queeny Avenue. This segment of the creek originally consisted of two holding ponds which were periodically dredged. For several years, CS-A and available downstream segments (*e.g.*, ones that were not blocked off) received direct wastewater discharges from industrial sources and served as a surcharge basin for the Village of Sauget (formerly the Village of Monsanto) municipal sewer collection system. When the system became backed up or overflowed, untreated wastes from industrial users of the sewer system were discharged directly into CS-A. On several occaisions, CS-A was dredged and contaminated sediments were disposed of onto adjacent Site I. In 1968, the Queeny Avenue culvert, which allowed creek water to pass from CS-A to CS-B, was permanently blocked by the Village of Sauget.

Remediation work was conducted by Cerro Copper in CS-A in 1990. Approximately 27,500 tons of contaminated sediments were removed to

RCRA and TSCA permitted facilities. CS-A is now filled and covered with crushed gravel. Land use surrounding CS-A is industrial.

Creek Segment CS-B extends for approximately 1800 feet from Queeny Avenue to Judith Lane. Sites G, L, and M border this creek segment. Land use surrounding CS-B is primarily commercial with a small residential area near the southern end of this segment. Agricultural land lies to the west of the creek and south of Site G. In 1965, the Judith Lane culvert, which allowed creek water to pass from CS-B to CS-C, was blocked. CS-B is hydrologically connected to Site M by a man-made ditch (see above).

Creek Segment CS-C extends for approximately 1300 feet from Judith Lane south to Cahokia Street. Site N borders this creek segment. Land use is primarily residential along both sides of CS-C.

Creek Segment CS-D extends for approximately 1100 feet from Cahokia Street to Jerome Lane. Land use is primarily residential along both sides of CS-D.

Creek Segment CS-E extends approximately 4300 feet from Jerome Lane to the intersection of Illinois Route 3 and Route 157. Land use surrounding CS-E is predominantly commercial with some mixed residential use. Dead Creek temporarily passes through corrugated pipe at the southern end of CS-E.

Creek Segment CS-F is approximately 6500 ft long and extends from Route 157 to the Old Prairie du Pont Creek. CS-F is the widest segment of Dead Creek, and a large wetland area extends several hundred feet out from both sides of the creek.

Information on the types of wastes disposed of and the types and levels of contamination found at the Sauget Area 1 Site have been provided to USEPA Region V from various sources, including, but not exclusively from: 1) CERCLA 103(c) Submittals; 2) CERCLA 104(e) Responses; 3) Expanded Site Investigation Dead Creek Project Sites (Ecology and Environment, 1988); 4) Removal Action Plan for Dead Creek Sites (Weston-SPER, 1987); 5) Description of Current Situation at the Dead Creek Project Sites (Ecology and Environment, 1986); 6) Site Investigations for Dead Creek Segment B and Sites L and M (Geraghty & Miller, Inc. 1992); 7) Site Investigation/Feasibility Study for Creek Segment A (Advent Group, 1990); 8) Preliminary Ecological Risk Assessment for Sauget Area 1, Creek Segment F (Ecology and Environment, 1997); 9) EPA Removal Action Report for Site G (Ecology and Environment 1994); 10) Area One Screening Site Inspection Report; and 11)

Site Investigation Feasibility Study for Creek Segment A (Advent Group 1990)."

Creek Segment A. "Approximately 20,000 cubic yards of contaminated material were removed from this segment of Dead Creek in 1990, and the area was then backfilled with clean material. The assumption that only low-levels of residual contamination may currently exist within CS-A is yet to be confirmed. Prior to remediation activities, soil and sediment samples collected from CS-A revealed elevated levels of VOCs such as 1,2-dichloroethene (15,000 ppb), trichloroethene (100,000 ppb), tetrachloroethene (11,000 ppb), chlorobenzene (31,000 ppb), ethyl benzene (80,000 ppb), and xylene (500,000 ppb). Elevated levels of SVOCs detected in soils and sediments included 1,3--dichlorobenzene, 4-chloroaniline (17,000 ppb), acetophenone (24,000 ppb), 1, 2, 4, 5-tetrachlorobenzene (28,000 ppb), pentachlorobenzene (37,000 ppb), phenathrene (14,000 ppb), and pyrene (10,000 ppb). Elevated levels of PCBs (total) were also detected at a maximum concentration of 3,145,000 ppb. Elevated levels of metals were also detected in soils and sediments in CS-A including silver (348 ppm), arsenic (194 ppm), cadmium (532 ppm), copper (91,800 ppm), mercury (124 ppm), nickel (6,940 ppm), lead (32,400 ppm), antimony (356 ppm), selenium (41.6 ppm), and zinc (26,800 ppm)."

Creek Segment B. "Elevated levels of VOCs and SVOCs were detected in sediment samples collected from CS-B such as benzene (87 ppb), toluene (810 ppb), chlorobenzene-(5,200 ppb), ethyl benzene (3,600 ppb), trichlorobenzene (3,700 ppm), dichlorobenzene (12,000 ppm), chloronitrobenzene (240 ppm), xylenes (540 ppm), 1,4-dichlorobenzene (220,000 ppb), 1,2-dichlorobenzene (17,000 ppb), phenanthrene (15,000 ppb), fluoranthene (11,000 ppb), pyrene (13,000 ppb). Elevated levels of PCBs exist within CS-B at levels as high as 10,000 ppm. Elevated levels of metals were also detected in sediments in CS-B including arsenic (6,000 ppm), cadmium (400 ppm), copper (44,800 ppm), lead (24,000 ppm), mercury (30 ppm), nickel (3,500 ppm), silver (100 ppm), and zinc (71,000 ppm).

Surface water samples collected from CS-B revealed elevated concentrations of VOCs such as chloroform (27 ppb), 1,1-dichloroethene (3 ppb), toluene (20 ppb), and chlorobenzene (33 ppb). SVOCs detected in surface water included phenol (28 ppb), 2-chlorophenol (14 ppb), 1,4-dichlorobenzene, 2-methyl phenol (4 ppb), 4-methyl phenol (35 ppb), 2,4-dichlorophenol (150 ppb), naphthalene (8 ppb), 3-nitroaniline (9 ppb), and pentachlorophenol (120 ppb). Pesticides were also detected in surface water samples including dieldrin (0.18

ppb), 4,4-DDT (0.24 ppb), 2,4-D (47 ppb) and Silvex (3.4 ppb). An elevated level of PCBs (Aroclor 1260) was also detected in the surface water of CS-B at a level of 44 ppb. Elevated levels of metals were detected in surface water such as aluminum (9,080 ppb), barium (7,130 ppb), arsenic (31 ppb), cadmium (25 ppb), chromium (99 ppb), copper (17,900 ppb), lead (1,300 ppb), mercury (8.6 ppb), nickel (1,500 ppb), and zinc (10,300 ppb)."

Creek Segment C. "Elevated levels of VOCs and SVOCs were detected in sediments in this segment of Dead Creek including fluoranthene (4,600 ppb), pyrene (4,500 ppb), benzo(a)anthracene (3,300 ppb), chrysene (4,400 ppb), benzo(b)fluoranthene (7,500 ppb), benzo(a)pyrene (4,500 ppb), indeno(1,2,3-cd)pyrene (4,300 ppb), benzo(g, h, l) perylene (1,500 ppb), dibenzo(a, h)anthracene (4,000 ppb), and 4-methyl-2-pentanone (1,200 ppb). PCBs (total) were also detected in sediments from CS-C at a maximum concentration of 27,500 ppb. Sediment samples also revealed elevated levels of metals such as copper (17,200 ppm), lead (1,300 ppm), nickel (2,300 ppm), zinc (21,000 ppm) and mercury (2.81 ppm).

Surface water samples collected from creek segment CS-C revealed elevated levels of metals such as lead (710 ppb), mercury (1.9 ppb), and nickel (83 ppb)."

Creek Segment D. "Elevated concentrations of VOCs and SVOCs were detected in sediment samples collected from CS-D including 4-methyl-2-pentanone (1,200 ppb), benzo(b)fluoranthene (500 ppb), indeno(1, 2, 3-cd)pyrene (310 ppb), and dibenzo(a, h)anthracene (360 ppb). PCBs (total) were detected in sediments at a maximum concentration of 12,000 ppb. Elevated concentrations of metals were also detected such as cadmium (42 ppm), copper (1,630 ppm), lead (480 ppm), mercury (1 ppm), and zinc (6,590 ppm).

Surface water samples collected from CS-D revealed elevated concentrations of metals such as cadmium (8.1 ppb), lead (89 ppb), and nickel (189 ppb)."

Creek Segment E. "Elevated concentrations of VOCs and SVOCs were detected in sediment samples collected from CS-E including chlorobenzene (120 ppb), pyrene (5,300 ppb), benzo(b)fluoranthene (2,400 ppb), and chrysene (2,800 ppb). Elevated levels of PCBs (total) were also detected at a maximum concentration of 59,926 ppb. Elevated levels of metals were also detected in the sediments of CS-E including cadmium (23.1 ppm), copper (8,540 ppm), lead (1,270 ppm), mercury (1.53 ppm), nickel (2,130 ppm), and zinc (9,970 ppm)."

Creek Segment F. "Elevated concentrations of VOCs and SVOCs were detected in the sediments of CS-F such as toluene (29 ppb), 4-methyl phenol (1,100 ppb), fluoranthene (310 ppb), and pyrene (340 ppb). Pesticides were also detected in the sediments such as 4,4-DDE (97 ppb), endrin (66 ppb), endosulfan 11 (203 ppb), and methoxychlor (8 ppb). PCBs (total) were also detected in sediments at a maximum concentration of 5,348 ppb. Elevated levels of metals were also detected in the sediments such as arsenic (276 ppm), lead (199 ppm), mercury (0.55 ppm), cadmium (23.5 ppm), copper (520 ppm), nickel (772 ppm) and zinc (4,520 ppm). Elevated concentrations of dioxins were also detected in sediments in CS-F at a maximum concentration of 211 picograms per gram."

1.1.9. Existing data

In 1998, Ecology and Environment prepared a report (Sauget Area 1 Data Tables/Maps) for USEPA Region V that "summarized existing technical and potentially responsible party (PRP) data for each subunit of the sites along with other information compiled during Ecology and Environment's file searches of various agencies and organizations." This report contains the following information obtained from work done by Illinois EPA (IEPA), Ecology and Environment (E&E), Weston, Geraghty & Miller (G&M) and The Advent Group.

Volume 1 - Sauget Area 1

Introduction
Report Organization
Site G
- Site Narrative
- Analytical Data Summaries
  - Sediment Samples - Organics and Metals (IEPA, 1984)
  - Surface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1986)
  - Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)
  - Soil Samples - PCB and PCP (Weston, 1987)
  - Waste/Soil Samples - Metals and Organics (IEPA, 1984)
  - Soil Samples - VOCs (G&M, 1991)
  - Soil Samples - BNAs, Metals, Pesticides/PCBs (E&E, 1986)

Soil Samples - VOCs, BNAs, Pesticides/PCBs (IEPA, 1994)

Site H

Site Narrative

Analytical Data Summaries

Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)

Site L

Site Narrative

Analytical Data Summaries

Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)

Soil Samples - PCBs (IEPA, 1981)

Sediment Samples - VOCs, BNAs, PCBs, Metals (G&M, 1991)

Subsurface Soil Samples - TCLP Metals, VOCs, BNAs, Pesticides/PCBs (G&M, 1991)

Site I

Site Narrative

Analytical Data Summaries

Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)

Creek Segment A

Site Narrative

Analytical Data Summaries

Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)

Sediment Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)

Surface Water Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1986)

Soil Samples - PCBs, Metals (IEPA, 1981)

Sediment Samples - Metals and Organics (IEPA, 1981)

Surface Water Samples - Metals and Organics (IEPA, 1981)

Soil/Sediment Samples - VOCs, BNAs, PCBs, PCB Precursors, Metals (Advent Group, 1990)

Site M

Site Narrative

Analytical Data Summaries

Surface Water Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)

Sediment Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1986)

Sediment/Surface Water Samples - VOCs, BNAs, Metals, PCBs, RCRA Hazardous Characteristic Parameters (G&M, 1992)

Water/Sediment Samples - Metals and Organics (IEPA, 1980)
Surface Water Samples - VOCs, BNAs, Pesticides/PCBs, Metals, Herbicides (IEPA, 1994)
Soil/Sediment Samples - Metals (IEPA, 1980)
Creek Segment B
Site Narrative
Analytical Data Summaries
Sediment Soil Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)
Surface Water Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)
Sediment Samples - BNAs, VOCs, Metals (G&M, 1991)
Soil/Sediment Samples - Metals, Pesticides/PCBs, VOCs, BNAs (G&M, 1991)
Sediment Samples - RCRA Hazardous Characteristic Parameters (G&M, 1991)
Soil Sediment Samples - Organics, Phosphorus, Metals (IEPA/Monsanto, 1980)
Surface Water Sample - Metals (Eastep, 1975)
Surface Water Samples - VOCs, BNAs, Metals, Pesticides/PCBs (IEPA, 1993/94)
Soil/Sediment Samples - Metals, Organics (IEPA, Sept. 1980)
Soil/Sediment Samples - Metals, Organics (IEPA, Oct. 1980)
Site N
Site Narrative
Analytical Data Summaries
Subsurface Soil Samples - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1986)
Creek Segment C
Site Narrative
Analytical Data Summaries
Sediment Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)
Surface Water Samples - VOCs, BNAs, Pesticides/PCBs, Metals, (E&E, 1986)
Sediment/Soil Samples - Metals and Organics (IEPA, 1980)
Water Samples - Metals and Organics (IEPA, 1980)
Soil Samples - Metals and Organics (IEPA, 1991)
Sediment Samples - Metals (IEPA, 1980)

Surface Water Samples - VOCs, BNAs, Metals, Pesticides/PCBs (IEPA, 1993)
Water Samples - Metals (IEPA, 1980)
Creek Segment D
Site Narrative
Analytical Data Summaries
Sediment Samples - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1986)
Surface Water Samples - VOCs, BNAs, Pesticides/PCBs, Metals, (E&E, 1986)
Sediment Samples - VOCs, SVOCS, Pesticides/PCBs, Inorganics, Metals (IEPA, 1991)
Creek Segment E
Site Narrative
Analytical Data Summaries
Sediment Samples - VOCs, SVOCS, Pesticides/PCBs, Inorganics, Metals (IEPA, 1991)
Sediment Samples - Metals and Organics (IEPA, 1980)
Water Samples - Metals and Organics (IEPA, 1980)
Sediment Samples - Metals (IEPA, 1980)
Water Samples - Metals (IEPA, 1980)
Creek Segment F
Site Narrative
Analytical Data Summaries
Sediment Samples - Metals, PCBs (E&E, 1997)
Soil/Sediment Samples - VOCs, SVOCs, Pesticides/PCBs (IEPA, 1991)
Sediment Samples - VOCs, SVOCs, Pesticides/PCBs, Inorganics, Metals (IEPA, 1991)
Soil/Sediment Samples - Metals and Organics (IEPA, 1990)
Area 1 Groundwater
Site Narrative
Creek Segment B - Metals/Indicators (IEPA, 1980)
Site G - VOCs, BNAs, Metals (E&E, 1987)
Site H - VOCs, BNAs, Pesticides/PCBs, Metals (E&E, 1987)
Site I - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1987)
Site L - VOCs, BNAs, Metals, Pesticides/PCBs (E&E, 1987)
Private Wells - VOCs, BNAs, Pesticide/PCBs, Metals (E&E, 1987)
Groundwater Monitoring Survey - Organics and Metals (IEPA, 1982)
Monitoring Well Samples - Metals, Pesticides/PCBs (IEPA, 1980 and 1983)
Groundwater Samples - VOCs, SVOCs, Pesticides/PCBs, Inorganics (IEPA, 1991)

Water Samples - PCBs (IEPA and Monsanto, 1980)
Groundwater Samples - Metals and Organics (IEPA, 1981)
Groundwater Samples - Metals and Organics (IEPA, 1981)
Groundwater Samples - VOCs, SVOCs, Pesticides/PCBs, Metals (IEPA, 1991)

The 1998 Ecology and Environment Sauget Area 1 Data Tables/Maps Report is not included in the SSP at the request of the Agency. A summary of this information will be included in the Support Sampling Plan Data Report.

1.1.10. Existing risk assessments

In 1997 Ecology and Environment prepared the report "Preliminary Ecological Risk Assessment for Sauget Area 1, Creek Segment F, Sauget, St. Clair County, Illinois". Ecology and Environment "was tasked by the United States Environmental Protection Agency (U.S. EPA) to prepare a screening-level ecological risk assessment for the Sauget Area 1, Creek Segment F site ... The objective of this report is to determine whether the site poses no immediate or long-term ecological risk, or if a potential ecological risk exists and further evaluation is necessary."

Conclusions and recommendations of the report are given below:

"Based on this investigation, site contamination does not appear to threaten human health. Sediment contamination levels are below risk-based values and few people enter the site boundaries.

Elevated levels of metals and PCBs may be highly detrimental to the ecology of this site [Creek Segment F]. The presence of arsenic, cadmium, and dioxin greater than SEL guidelines may decrease the species richness of the area. Sensitive species, including the endangered Black-Crowned Night Heron, inhabit the site and therefore, are subject to effects such as acute toxicity, reduced growth, inhibited reproduction, and other adverse effects. Finally, species that feed on contaminated organisms may bioaccumulate the contaminants and become adversely affected.

The contamination on the site [Creek Segment F] warrants further investigation and possible remediation, especially because it provides high quality wetland habitat."

This report is included in the SSP as Appendix A.

2. Project organization and responsibilities

O'Brien & Gere will perform the field activities, prepare the report, and provide project management. Analytical services for this SSP will be provided by Savannah Labs & Environmental Services, Inc. (Savannah Labs) in Savannah, Georgia. Analytical services for dioxin and dibenzofuran for this Support Sampling Project will be provided by Triangle Laboratories, Inc. (Triangle Labs) in Durham, North Carolina. The responsibilities of key project personnel are described below. The responsibilities of key laboratory personnel are described in section 2.5 of the QAPP.

2.1. Project organization

Sections 2.2 through 2.4 of this FSP present the responsibilities of the key project personnel and the lines of authority for the project personnel are described in each section.

2.2. Management responsibilities

2.2.1. USEPA Region V remedial project manager

Michael McAteer will serve as the USEPA Region V Remedial Project Manager (USEPA RPM). As such, he will have overall responsibility for all phases of the Support Sampling Project.

2.2.2. Illinois Environmental Protection Agency (IEPA) remedial project manager

Candy Morin will serve as IEPA Remedial Project Manager.

2.2.3. Solutia Inc. remedial project manager

Bruce S. Yare, of Solutia will serve as the Solutia RPM. As such, he will have the overall responsibility for all phases of the Support Sampling Project. He will be responsible for implementing the project, and will have the authority to commit the resources necessary to meet project objectives and requirements. The Solutia RPM's primary function is to verify that technical, financial, and scheduling objectives are achieved successfully. The Solutia RPM will report directly to USEPA Region V and will provide the major point of contact and control for matters concerning the project. The Solutia RPM will:

- Define project objectives and develop a work plan schedule
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task
- Acquire and apply technical and corporate resources as needed to verify performance within budget and schedule constraints
- Monitor and direct the field leaders
- Develop and meet ongoing project staffing requirements
- Review the work performed on each task to verify its quality, responsiveness, and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Approve all reports before their submission to USEPA Region V
- Ultimately be responsible for the preparation and quality of reports
- Represent the project team at meetings.

2.2.4. O'Brien & Gere project officer

Dean L. Palmer, PE, will serve as the O'Brien & Gere Project Officer. As such, he is responsible for the overall administration and technical execution of the project. He will report directly to the Solutia RPM.

2.2.5. O'Brien & Gere project manager

Alan J. Cork, PE, will serve as the O'Brien & Gere Project Manager (PM). As such, he will have overall responsibility for verifying the project meets USEPA Region V's objectives and O'Brien & Gere's quality standards. He will provide assistance to the Solutia RPM in terms of writing and distributing the QAPP to those parties connected with the project (including the laboratory). He will report directly to the O'Brien & Gere Project Officer and is responsible for technical quality control and project oversight.

2.3. Quality assurance (QA) responsibilities

2.3.1. Environmental Standards data validator

Kathy Blaine of Environmental Standards in Belleville, Illinois will serve as the third-party data validator. As such, she will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff, as necessary, to resolve QA dispute. The data validator will be responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, O'Brien & Gere's policies, and USEPA Region V requirements. The specific functions include:

- Providing QA audits on various phases of the field operations
- Reviewing and approving the QA plans and procedures
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Solutia RPM
- Data validation of all sample results from the analytical laboratory.

2.3.2. O'Brien & Gere QA officer

Karen Storne will serve as the O'Brien & Gere QA Officer (QAO). As such, she will report directly to the O'Brien & Gere PM and will be responsible for verifying that O'Brien & Gere QA procedures for this project are being followed. In addition, she will be responsible for internal laboratory audits. The O'Brien & Gere PM is responsible for field quality assurance activities.

2.3.3. USEPA Region V quality assurance reviewer

Michael McAteer, the USEPA Region V RPM, or a designee, will serve as the USEPA Region V Quality Assurance Reviewer. As such, he will have the responsibility to review and approve the QAPP. In addition, he will be responsible for conducting external performance and system audits of the laboratory and field activities, and review and evaluate analytical laboratory and field procedures.

2.4. Field responsibilities

2.4.1. O'Brien & Gere field leader

David E. Haverdink, or a designee, will serve as the O'Brien & Gere Field Leader. He will be responsible for leading, coordinating, and supervising the day-to-day field activities. His responsibilities include:

- Provision of day-to-day coordination with the O'Brien & Gere PM on technical issues
- Develop and implement field related work plans and schedule
- Coordinate and manage field staff
- Supervise or act as the field sample custodian
- Implement the QC for technical data, including field measurements
- Adhere to work schedules
- Authorize and approve text and graphics required for field team efforts
- Coordinate and oversee technical efforts of subcontractors assisting the field team
- Identify problems at the field team level, resolve difficulties in consultation with the O'Brien & Gere PM, implement and document corrective action procedures, and provide communication between team and upper management
- Prepare the final report.

2.4.2. O'Brien & Gere field team

The technical staff (William E. Wright and Joseph W. Perry) will be drawn from O'Brien & Gere's pool of corporate resources. The technical staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. The technical staff are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

3. Project scope and objectives

The purpose of the SSP is to gather sufficient information from the Sauget Area 1 Site to identify the nature of waste materials in Sites G, H, I, L, M, and N and to assess the extent of constituent migration in soil, ground water, surface water, sediments, and air at the site.

Collected data will be used by others to prepare a Human Health Risk Assessment (HHRA), an Ecological Risk Assessment (ERA), an EE/CA for soil, surface water, sediments, and air, and an RI/FS for ground water. The EE/CA and RI/FS SSP (Solutia Inc. 1999) and this FSP include a description of the sample media, sample locations, number of samples, and analytical methods.

The main components of the SSP addressed in this FSP include:

- Source area sampling (soil gas sampling, waste sampling, buried drum and tank identification)
- Ground water sampling (upgradient, fill areas, down gradient alluvial aquifer, bedrock, domestic wells, slug tests, and grain size analysis)
- Soil sampling (undeveloped areas, developed areas, and background)
- Sediment sampling (undeveloped areas, developed areas, Borrow Pit Lake, and Dead Creek)
- Surface water sampling
- Air sampling
- Pilot test sampling.

Site plans showing sampling locations are located on Figures 1-11 of this FSP.

3.1. Site characterization

The January 21, 1999 Administrative Order on Consent Scope of Work identified the site characterization information needed to define the extent of contamination at Sauget Area 1 for purposes of implementing a removal action on the source areas and Dead Creek and for implementing a remedial action for ground water. In addition, an analysis of currently available data was done to determine the areas of the Site that required characterization data in order to define the extent of contamination for purposes of implementing a removal action on the source areas and Dead Creek and for implementing a remedial action for ground water.

Sections 5 to 12 of the SSP and section 5 of this FSP address activities designed to provide site characterization data. These chapters describe the number, types, and locations of additional samples that will be collected as part of the SSP.

3.1.1. Waste characterization

The AOC SOW requires inclusion of a program in the SSP for characterizing the waste materials at the Site including an analysis of current information/data on past disposal practices, test pits/trenches, and deep soil borings to determine waste depths and volume and extent of cover over fill areas, soil gas surveys on and around fill areas, and geophysical delineation of potential "hot spot" drum removal areas. Based on the AOC SOW requirements, meetings and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, the identified waste characterization data include:

- Past disposal practices
- Waste depths and volumes
- Extent of cover over fill areas
- Soil gas survey on and around fill areas
- Buried drum and tank identification.

Section 5.0 of the SSP, Waste Characterization Sampling Plan, describes the work that will be performed to obtain waste characterization data. This corresponds to sections 5.1 to 5.5 of the FSP.

3.1.2. Hydrogeology

The AOC SOW requires inclusion of a program in the SSP for performing a hydrogeologic investigation at the Site including assessment of the degree of hazard, regional and local flow direction and quality, and local uses of ground water. In addition, the SSP was required to develop a strategy for determining horizontal and vertical distribution of contaminants and to include slug tests, grain size analyses and upgradient samples. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, the identified ground water characterization data include:

- Degree of hazard and mobility of constituents
- Discharge and recharge areas
- Regional and local flow direction and quality
- Local uses of groundwater
- Horizontal and vertical distribution of constituents
- Slug tests
- Grain size analyses
- Upgradient samples.

Section 6.0 of the SSP, Ground Water Sampling Plan, describes the work that will be performed to obtain ground water characterization data. This corresponds to sections 5.6 to 5.16 of the FSP.

3.1.3. Soil

The AOC SOW requires inclusion of a program in the SSP for performing a soil investigation at the Site to determine the extent of contamination of surface and subsurface soils. Sampling of leachate from the fill areas,and sampling of soil in commercial/open areas adjacent to Dead Creek were also required. The AOC SOW indicated that residential soil sampling may also be required depending on the results from the commercial/open area sampling. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, soil characterization data include:

- Extent of contamination of surface and subsurface soils
- Leachate samples from fill areas
- Soil sampling of residential/commercial areas adjacent to Dead Creek

Section 7.0 of the SSP, Soil Sampling Plan, describes the work that will be performed to obtain soil characterization data. This corresponds to sections 5.17 to 5.19 of the FSP.

3.1.4. Sediment

The AOC SOW requires inclusion of a program in the SSP for performing a sediment investigation at the Site to determine the extent and depth of contaminated sediments in all segments of Dead Creek and its tributaries and surrounding wetland areas. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, sediment characterization data include:

- Extent and depth of contamination in sediments

Section 8.0 of the SSP, Sediment Sampling Plan, describes the work that will be performed to obtain soil characterization data. This corresponds to section 5.20 of the FSP.

3.1.5. Surface water

The AOC SOW requires inclusion of a program in the SSP to determine the areas of surface water contamination in Dead Creek and its tributaries and surrounding wetland areas. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, surface water characterization data include:

- Areas of surface water contamination in Dead Creek and its tributaries and surrounding wetland areas.

Section 9.0 of the SSP, Surface Water Sampling Plan, describes the work that will be performed to obtain surface water characterization data. This corresponds to section 5.21 of the FSP.

3.1.6. Air

The AOC SOW requires inclusion of a program in the SSP to determine the extent of atmospheric contamination from the various source areas at the Site and to address the tendency of substances identified through waste characterization to enter the atmosphere, local wind patterns, and their degree of hazard. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, air characterization data include:

- Tendency of constituents to enter the atmosphere
- Tendency of constituents to enter local wind patterns
- Degree of hazard.

Section 10.0 of the SSP, Air Sampling Plan, describes the work that will be performed to obtain air characterization data. This corresonds to section 5.22 of the FSP.

3.1.7. Ecological assessment

The AOC SOW requires inclusion of a program in the SSP to collect data for the purpose of assessing the impact, if any, to aquatic and terrestrial ecosystems within and adjacent to Sauget Area 1 resulting from the disposal, release, and migration of contaminants. This program must include a description of ecosystems affected, an evaluation of toxicity, an assessment of endpoint organisms, and exposure pathways. It also must include a description of toxicity testing or trapping to be done as part of the assessment. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston and IEPA and a review of the 1998 Ecology and Environment report, ecological assessment includes:

- Affected ecosystem description
- Evaluation of toxicity
- Assessment of endpoint organisms
- Exposure pathways
- Toxicity testing or trapping.

Section 11.0 of the SSP, Ecological Assessment Sampling Plan, describes the work that will be performed to obtain data for the ecological assessment.

3.1.8. Pilot treatability tests

The AOC SOW requires inclusion of a program in the SSP for any pilot tests necessary to determine the implementability and effectiveness of technologies where sufficient information is not otherwise available. Based on the AOC SOW requirements, meetings, and telephone conversations with USEPA, USACE, Weston, and IEPA and a review of the 1998 Ecology and Environment report, pilot treatability tests include:

- Waste Incineration
- Waste Thermal Desorption
- Sediment Thermal Desorption
- Sediment Stabilization
- Leachate Treatment.

Section 12.0 of the SSP, Pilot Treatability Test Sampling Plan, describes the work that will be performed to perform these pilot treatability tests. This corresponds to section 5.23 of the FSP.

3.2. Project schedule

The estimated project schedule is presented in Volume 1A, section 16.0 of the SSP.

4. Non-measurement data acquisition

4.1. Topographic map and sample location surveying

4.1.1. Topographic map

Surdex, an aerial photography and mapping subcontractor, flew the study area in late March to obtain current aerial photographs of the study area prior to the spring emergence of vegetation. These photographs, combined with ground control surveying, will be used to prepare a topographic map of the study area with a 1 inch = 50 foot scale and a topographic contour interval of 1 ft. This map will consist of seventeen 30-inch by 40-inch sheets, and it will meet National Map Standards with a horizontal accuracy of +/- 1.25 ft and a vertical accuracy for contour lines of +/- 0.5 ft.

4.1.2. Location and elevation surveying

Information submitted to USEPA Region V and IEPA describing sampling locations will be identified in the field using a global positioning satellite (GPS) system capable of producing decimal latitude and longitude readings having a horizontal accuracy of one meter or less. Well elevations will be surveyed to an accuracy of ±0.01 ft. Information submitted to USEPA Region V and IEPA must be in a Microsoft Excel®-compatible electronic spreadsheet and must include columns on:

- Latitude (decimal degrees)
- Longitude (decimal degrees)
- Sample identification
- Sample description (*e.g.*, soil, ground water)
- Locational method
- Sample depth
- Time and date of sample collection
- Time and date of sample analysis

- Chemical parameter
- Chemical result
- Analysis method
- Detection limit
- Chemical units (ppm, ppb, mg/kg, etc.)
- Result qualifier (non-detect, etc.).

4.2. Aerial photograph acquisition and analysis

Available historical air photographs not included in the 1988 Ecology and Environment report will be obtained for Sites G, H, I, L, and N. These photographs, and the results of the E&E evaluation, will be used to define the areal extent of each site. Boundaries of the waste disposal areas will be defined using historical aerial photographs to establish the areal extent of excavation and fill areas over time. For each photo, the boundaries of Sites G, H, I, L, and N will be traced and input into an AutoCAD file. To define the extent of fill, the AutoCAD files will be overlain for each site and a line will be drawn around the outside boundary of the composite fill areas. If stereoscopic evaluation of historical aerial photographs allows identification of the deepest portion of the fill area, one of the four waste characterization borings will be conducted at that location.

Results of the analysis of historical aerial photographs will be used to prepare a map for each site showing fill area boundaries and the final selected locations of the boundary confirmation trenches and the waste characterization borings. When the map for each fill area is completed, it will be submitted to USEPA Region V for acceptance prior to performance of the boundary confirmation trenching or collection of the waste characterization samples.

Boundary confirmation trenches and waste characterization borings will be located in the field by measuring from known points, such as buildings, roads, or other cultural features or by using GPS.

5. Field activities by area of concern

5.1. Source area boundaries delineation - test trenches

5.1.1. Rationale/design

Preliminary boundary confirmation trench and waste characterization boring locations are shown on Figures 2 and 3. Test trenches will be used to confirm the boundaries of the fill areas identified through aerial photograph analysis. One trench will be installed on each side of a fill area, a total of four trenches per site. The four trenches will be located at the midpoint of the four longest sites of the defined boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the fill area and move toward the defined boundary. When fill materials are encountered, the fill area boundary will be considered confirmed and trenching at that location will be terminated. Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums, which will be removed provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using GPS and recorded for future reference in the event drum removal is appropriate. Drums recovered during trenching activities will be handled by the drum removal contractor in accordance with the requirements of 29 CFR 1910.120 (j). Recovered drums will be overpacked and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste, and contaminated soil in bulk containers at a controlled-access, fenced, investigation-derived waste storage area to be constructed north of Judith Lane adjacent to Dead Creek. Overpacked drums will be also be stored at this facility. Recovered drums will be stored until the capacity of the storage pad is exceeded or the investigation is completed, whichever comes first. Drum and waste storage may be indefinite if they contain materials that can not be accepted by off-site disposal facilities (*e.g.*, dioxin). Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

- Number of test trenches..........20

Sampling locations will be selected in the field with the concurrence of USEPA Region V, or its designee. Trenching equipment will be hired on a per-day basis. If all or part of the planned twenty boundary trenches are finished before the end of a day, additional trenches will be installed at locations directed by USEPA Region V for the remainder of the day, provided these areas are covered by access agreements.

5.1.2. Waste volumes

Waste volume will be established using the areal extent information obtained from historical aerial photo analysis and boundary confirmation trenching and the depth of fill information obtained from the waste characterization borings at each site.

5.1.3. Field procedures

Test trench locations will be selected in the field with the concurrence of USEPA Region V or its designee and noted in the field notebook. A "competent" person," as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. To complete the test trenches, a track-mounted hoe with an extended arm will be used to provide the capability to excavate to a maximum depth of 40 ft below grade. All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations. A photoionization detector (PID), an explosimeter, and a real time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system.

Test trenches will be advanced to a maximum depth of 40 ft, where possible. Should ground water infiltration and/or poor soil stability result in the inability to complete a test trench to 40 ft, the trenching will be terminated at that location. No accommodations will be made to dewater test trenches or manage ground water during excavation activities in order to minimize the generation of investigation-derived wastes.

Additionally, should waste materials be encountered during trenching at a boundary, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location. As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 mil. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Prior to handling the cover material, the excavator bucket will be grossly decontaminated using a shovel and/or a potable water source. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed. Handling of investigation-derived wastes from these activities is discussed in Chapter 9.

5.1.4. Documentation

During trenching activities, a representative of O'Brien & Gere will complete a descriptive log for each test trench completed. At a minimum the following information will be included in the log:

- The date, time, weather conditions, equipment, and personnel on-site
- The total depth, length, and width of the test trench
- The depth and total thickness of distinct soil or lithologic units encountered

- A description of any waste excavated, as well as the identification of the source of the material, where possible
- PID, explosimeter, and RAM readings.

Additionally, the location of the test trenches will be laid out on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

5.2. Soil gas survey

5.2.1. Rationale/design

A soil gas survey will be conducted at Sites G, H, I, L, and N using a shallow soil probe (5 ft) and on-site analysis of collected vapors for VOCs. Soil gas samples will be collected at a frequency of one sample per acre. Each sample will be collected at the center point of each grid cell using the following grid spacings (Figures 5 and 6):

Site	Grid Size	Grid Spacing	Number of Samples
G	400' x 600'	200' x 200'	6
H	400' x 800'	200' x 200'	8
I	400' x 1,200'	200' x 200'	12
L	200' x 200'	200' x 200'	1
N	300' x 300'	200' x 200'	2
		Total number of samples	29

If detectable concentrations of VOCs are found in the fill area soil gas samples, the survey will be extended beyond the boundary of the fill area. A total of twelve additional soil gas samples will be collected at each fill area. Soil gas samples will be collected at 100-ft intervals (0, 100, and 200 ft from the edge of the fill area) along four 200-ft long transects (three samples per transect); one transect perpendicular to each side of the fill area. If VOCs are detected in soil gas at each of the five fill areas, a total of sixty additional soil gas samples will be collected:

Site	Number of Transects	Number of Samples
G	4	12
H	4	12
I	4	12
L	4	12
N	4	12
Total number of samples		60

If twelve additional soil gas samples are not adequate to define the extent of VOC-containing soils associated with each fill area, additional soil gas samples will be collected at 100-ft intervals along the four sampling transects at each fill area until the limits of the impacted fill are found. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 1 is a sample and analysis summary for this activity.

5.2.2. QA/QC samples

As this work is to field-screen soil vapors for total VOCs, QA/QC samples such as duplicates will not be collected. The field GC will be calibrated twice daily using the equipment manufacturer's standard operation procedures (SOPs).

5.2.3. Field procedures

A direct push technology will be used to advance a membrane interface probe (MIP) to 5 ft below existing grade. The MIP is a 3-ft long steel tool equipped with a point capable of penetrating relatively soft subsurface materials. Limiting constraints are free water and hard subsurface materials. Enclosed within the steel tubing is a polymer membrane, carrier gas tubes, and electrical wiring cables. The membrane is heated to 120 degrees Centigrade, allowing the migration of soil gases across the membrane and into the carrier gas chamber. The carrier gas captures the soil gases and feeds the sample directly to the GC. The GC then analyses the sample and provides a report of total VOC concentrations. The estimated detection limit of the field GC for total VOCs is 1 $\mu g/kg$. Soil gas probing holes will be sealed with grout (hydrated granular bentonite) following completion of sampling and analysis. An SOP for the field GC is contained in Appendix A.

5.2.4. Documentation

A field notebook will be kept for the soil gas survey. At a minimum, the field notebook will include project name and number, sample locations, dates and times, weather conditions, sampler's name, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site, limiting field conditions, and problems encountered. USEPA Region V acceptance of sampling locations will be noted in the field notebook. A report of analysis for total VOCs will be generated on a daily basis.

5.3. Waste sampling

5.3.1. Rationale/design

Four soil borings will be installed at Sites G, H, I, L, and N, and continuous soil samples will be collected from grade to 2 ft below the bottom of the fill material which is assumed to be 40 ft below grade (Figures 2 and 3). A discrete surface soil sample, from 0 to 0.5 ft, will also be collected at the location of the four soil borings at Sites G, H, I, L, and N. The surface soil samples analyzed will be used in the Human Health Risk Assessment (Volume 1B). Color digital photographs of each soil sample will be taken against a scale to provide a record of materials present in each fill area (Sites G, H, I, L, and N).

One composite waste sample will be collected at each boring location and analyzed for the waste disposal characteristics listed below. One discrete surface soil sample will be collected at each boring location and analyzed as listed below. Visual observation (discoloration) and PID readings will be used to identify whether waste is present in a continuous boring sample. If waste is present, it will be removed, segregated, temporarily stored, and used at the completion of the soil boring to prepare a composite waste sample. Since VOC samples can not be composited without losing volatiles, the waste sample with the highest PID readings will be used for VOC analysis. VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Experience at Sauget Area 2 Site R indicates that fill depth is unlikely to be greater than 40 ft. If wastes are encountered at depths greater than 40 ft below ground surface, borings will continue until the bottom of the fill is encountered.

Site M will be characterized by collecting four sediment samples at the preliminary locations shown on Figure 4.

Existing information (*e.g.*, the 1988 Ecology and Environment report and the results of the aerial photograph analysis, soil gas surveys, and magnetometer surveys conducted as part of the SSP) will be used to select boring locations.

Number of Waste Samples (composite boring sample): 24

Analyses:	Ignitability	USEPA Method 1010/1020A
	Corrosivity	USEPA Method 1110
	Reactivity	USEPA Method 9014
	TCLP	USEPA Method 1311
	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxins	USEPA Method 8280A

Number of Waste Samples (discrete surface sample): 20

Analyses:	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A

Cyanide	USEPA Method 9010B
PCBs	USEPA Method 680
Pesticides	USEPA Method 8081A
Herbicides	USEPA Method 8151A
Dioxins	USEPA Method 8280A

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in the one waste characterization boring completed at Site G and one waste characterization boring completed at Site I to provide samples for leachate treatability testing.

Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Tables 2 and 3 are sample and analysis summaries for these activities.

5.3.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.3.3. Field procedures

Borings will be advanced using conventional hollow stem auger drilling methods using 4.25-inch inside diameter (ID) augers. Continuous 1.5-inch outside diameter (OD), 2-ft long split spoon samples will be collected from the surface to the bottom of waste material. A discrete surface soil sample will be collected at each boring location prior to the completion of the boring activities. At each 10-ft interval of waste, a 3-inch OD split spoon sampler will be used to collect waste samples for laboratory analysis. Waste samples will be collected as presented below. Descriptive logs of each boring will be prepared as described below. A 2-inch OD stainless steel well will be installed in the borings of Sites G and I. The stainless steel wells will be installed following the procedures described below. Borings not used for the installation of sampling wells will be grouted to the surface to seal the borings. Boring equipment will be decontaminated as described below. Investigation derived waste will be disposed of as described below. A PID, explosimeter, and RAM will be used on a continuous basis to monitor the activities associated with waste sampling and well installation.

Waste sample collection. Waste samples will be collected using a 3-inch OD split spoon sampler. The split spoon sample will be obtained in accordance with ASTM Method 1586, with the exception of using a 3-inch OD split spoon. The following method will be used to collect waste samples.

1. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples. Sample containers will have a Teflon® septa.

2. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.

3. Place labeled sample containers near the sampling location.

4. Place clean plastic sheeting on the ground surface at the split spoon descriptive logging/sampling area

5. Put on a pair of nitrile gloves.

6. To collect a discrete waste sample for VOC analysis, a 5-gram EnCore® sampler will be used. After pressing the sampler into the soil at the desired location within the split spoon, cap the coring body while it is still in the EnCore® sampler T-handle. The remainder of the split spoon sample will be placed into a stainless steel bowl and homogenized. The remaining

sample containers will be filled from the steel bowl. For the discrete surface samples to be collected, the EnCore® sampler will be directly pushed into surface soils and handled as above.

7. Place the sample containers on ice in a cooler.

8. Begin chain-of-custody procedures. A sample chain-of-custody form is included as Appendix B.

9. Decontaminate the spoon/spatula and the steel bowl.

Logging unconsolidated samples. The geologist who logs samples is responsible to interpret the samples following standard and acceptable methods. The geologist who implements this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials.

At the outset of sample logging, the on-site geologist will record field notes with waterproof ink in a bound field notebook. At a minimum, the daily field notes will include:

- Project name and number
- Date and time
- Weather conditions
- Sampler's name
- Project objective(s).

Throughout the sampling round, the following items will be recorded as appropriate:

- Sample location(s)
- Sample identifications
- Well designations
- Limiting field conditions
- Problems encountered.

A copy of the test boring log to be used is included as Appendix C.

Unconsolidated soil samples will be described as follows:

- Descriptive information:
  - Color name, Munsell Color Chart, of the logged interval or sample
  - Color notation including chroma, hue, value, and qualifiers
  - Mottling with abbreviations, descriptors, and criteria for descriptions of mottles as identified below

Descriptors for mottling.

Abundance	Size	Contract
f: few (<2%)	fine (<5 mm)	faint
c: common (2%-20%)	medium (5-5mm)	distinct
m: many (>20%)	coarse (>15 mm)	prominent

- Degree of saturation (dry, damp, moist, wet, saturated, or combinations); note depth to ground water table, if observed.

- Degree of density. Count the blows of each 12-inch increment of the split spoon (ASTM-1586-84). Use the values in the table below to describe the density.

Terms to describe density.

Cohesive clays		Non-cohesive granular soils	
0-2	very soft	0-3	very loose
2-4	soft	4-9	loose
5-7	firm	10-29	medium dense
8-15	stiff	30-49	dense
16-29	hard	50-80	very dense
30-49	very hard	80+	extremely dense
50-80	extremely hard		

- Soil description according to ASTM's Unified Soil Classification System (USC) and by structure, according to the descriptions listed below:

  - ASTM Unified Soil Classification: Coarse-grained soils include clean gravels and sands and silty or clayey gravels and sands with more than 50% retained on the No. 200 sieve. The following table presents the grade limits and grade names used by engineers according to ASTM standards D422-63 and D643-78.

Grain size scale used by engineers.

Grade limits		Grade names		
mm	**inch**	**US standard sieve series**		
				boulders
305	12.0			
				cobbles
76.2	3.0	3.0 inch		
				gravel
4.75	0.19	No.4		
2.00	0.08	No. 10		
			medium	sand
0.425		No. 40		
0.074		No. 200		
				silt
0.005				
				clay size

Source: AGI data sheet 29.2

The following table shows the USC symbols and typical names of coarse-grained soils.

Coarse-grained soils: USCS symbols and typical names.

USCS symbol	Typical names
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sand, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures

Fine-grained soils include inorganic and organic silts and clays; gravelly, sandy, or silty clays; and clayey silts with more than 50% passing the No. 200 sieve. The following table shows the USC symbols and typical names of fine-grained soils.

Fine-grained soils: USCS symbols and typical names.

USCS symbol	Typical names
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity (residual clays), fat clays
OH	Organic clays of medium to high plasticity, organic silts
Pt	Peat and other highly organic soils

Soil descriptors are as follows:

- **Calcareous**: containing appreciable quantities of calcium carbonate
- **Fissured**: containing shrinkage cracks, often filled with fine sand or silt, usually more or less vertical
- **Interbedded**: containing alternating layers of different soil types

- **Intermixed**: containing appreciable, random, and disoriented quantities of varying color, texture, or constituency
- **Laminated**: containing thin layers of varying color, texture, or constituency
- **Layer**: thickness greater than 3 inches
- **Mottled**: containing appreciable random speckles or pockets of varying color, texture, or constituency
- **Parting**: paper thin
- **Poorly graded (well sorted)**: primarily one grain size, or having a range of sizes with some intermediate size missing
- **Slickensided**: having inclined planes of weakness that are slick and glossy in appearance and often result in lower unconfined compression cohesion
- **Split graded**: containing two predominant grain sizes with intermediate sizes missing
- **Varved**: sanded or layered with silt or very fine sand (cyclic sedimentary couplet)
- **Well graded (poorly sorted)**: containing wide range of grain sizes and substantial amounts of all intermediate particle sizes
- **Modifiers**:
  - Predominant type - 50% to 100%
  - Modifying type - 12% to 50%
  - With - 5% to 12%
  - Trace - 1% to 5%

The table below presents the terms used to denote the various degrees of plasticity of soil that passes the No. 200 sieve.

Plasticity.

Descriptive term	Degree of plasticity	Plasticity index range
SILT	none	non-plastic
Clayey SILT	slight	1-5
SILT & CLAY	low	5-10
CLAY & SILT	medium	10-20
Silty CLAY	high	20-40
CLAY	very high	over 40

Items of information relating to drilling will be included on the log as follows:

- Drill rig manufacturer, model, and driller (if applicable)
- Geologist or geotechnical engineer
- Project name, sample point identification, and location
- Date samples obtained (and times if required)
- Type of sampler (for example, split spoon, Shelby, California), measurements or method of advancing boring or equipment, method of driving sampler, and weight of hammer.
- Drill fluids (if applicable)
- Ground surface or grade elevation (if known)
- Depth penetrated and blow counts/6-inch interval of penetration for ASTM 1586-84 and sample number (if applicable)
- Closed hole intervals and advancement (if applicable)
- Recovery
- Strata changes and changes within samples
- Sampling tool behavior
- Drill string behavior
- Use(s) of sample point or borehole
- Disposition(s) of residual soil or cuttings
- Signature or sampling of log (as required) .

Sampling point well installation. Sampling point monitoring wells will be constructed of a 5-ft section of 2-inch ID, manufactured wire-wound, 0.010-inch slotted stainless steel well screen and appropriate lengths of compatible 2-inch ID solid, threaded, flush-joint stainless steel riser. Following installation of the sampling wells, the tops of casing and ground surface will be surveyed to establish well and grade elevations and well locations. Well installation details will be documented on a test boring log (Appendix C) and in the field notebook. The sampling point wells will generally be installed according to the typical well construction diagrams in Appendix D and as follows:

- Well materials will be inspected for proper specifications and integrity.

- The well screen, bottom cap, plug, and riser will be certified clean from the manufacturer. If they are not, they will be cleaned with a high-pressure steam cleaner.

- The total depth of the borehole will be measured referenced to existing grade and recorded. The quantities and lengths of all materials placed in the borehole will be measured and recorded. These materials include, but are not limited to: screen interval, blank casing or riser length, filter pack, bentonite seal, grout, and protective casing.

- The screen (with bottom cap) and riser assembly will be installed such that its midpoint approximately intersects the ground water table in the shallow ground water monitoring wells. The entire thickness of the intermediate aquifer will be screened. The well must be straight and vertical. Centralizers will be used as necessary to keep the monitoring well centered in the borehole.

- The filter pack will consist of an appropriately graded, washed silica sand, the thirtieth percentile grain size value of which must be four to ten times the equivalent thirtieth percentile grain size value of the stratum being monitored. The filter pack material will have a uniformity coefficient less than or equal to 2.5. The volume of filter pack necessary to fill the annular space will be computed and used to monitor the progress of installing the filter pack. The filter pack will be emplaced in increments to prevent bridging. If bridging occurs, the bridge will be broken before proceeding. The depth of the filter pack will be continuously checked with a weighted tape. The filter pack will extend a minimum of 2 ft above the top of the well screen.

- The augers or temporary casing will be withdrawn in no more than 5-ft increments to limit borehole collapse during emplacement of the filter pack. The lowest point of the casing or auger will not be more than 2 ft higher than the top of the filter material.

- A bentonite slurry seal will be tremied in place above the filter pack. The bentonite slurry seal will extend a minimum of 2 ft and not more than 3 ft above the top of the filter pack.

- A cement and bentonite grout mixture consisting of 5% bentonite by weight and Portland Type I cement will be tremied in place above the top of the bentonite slurry seal to 3 ft below existing grade. The grout mixture will be installed from the top of the bentonite seal upward to reduce the opportunity for the development of void spaces in the emplaced grout. The grout mixture must be pH neutral so as not to modify the pH of the ground water.

- A protective casing will be installed which extends from below the frost line to slightly above the top of the well casing. A weep hole will be drilled into the protective casing so accumulated water can drain.

- The concrete to be used to complete surface installation will be a commercially available, premixed cement, sand, and gravel mixture (*e.g.*, Quickrete) .

Equipment decontamination. Decontamination of drilling and soil sample collection equipment will be performed prior to initiating drilling procedures, between boring locations, and at the completion of the drilling program prior to removal of equipment from the site. Drilling equipment and associated tools, including augers, drill rods, wrenches, auger shoes, split spoon samplers, and other equipment, that comes into contact with generated soils will be decontaminated by spray- washing with a high-pressure steam-cleaner. Prior to decontaminating the augers, as much soil as is practical will be removed and placed into the drum(s) associated with that particular boring location. A decontamination station will be set up by the drilling contractor such that decontamination fluids can be contained in drums. Decontamination solids will be placed with drummed soil cuttings. The split spoon sampler will be decontaminated with an Alconox soap wash, followed by a potable water rinse between sample collection at a particular location. The split spoon sampler will be decontaminated utilizing the high pressure steam cleaner between boring locations.

Disposal of investigation-derived wastes. During the subsurface investigation, subsurface soils, ground water, decontamination water, and general waste (plastic, paper, etc.) will be generated. Subsurface soils, ground water (development and purge water), and equipment decontamination water will be temporarily contained in drums and transferred to waste containers. General waste will be contained in plastic bags and disposed in a general refuse container. If appropriate, a portion of the waste cuttings may be used for treatability test samples.

5.3.4. Documentation

A field notebook will be kept for the soil boring installation. At a minimum, the field notebook will include project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other project personnel on-site. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook.

5.4. Magnetometer survey

5.4.1. Rationale/design

Magnetometer surveys will be conducted at Sites G, H, I, L, and N to identify anomalies indicative of drum disposal or buried tanks. To evaluate whether the anomalies are associated with buried drums or tanks, test trenches will be dug at anomalies that coincide with ground water isoconcentrations greater than 10,000 ppb as identified by the 1998 Ecology and Environment Data Report, soil vapor extraction (SVE)anomalies detected during the soil gas survey, magnetic anomalies identified by the 1988 Ecology and Environment geophysical surveys, and areas of drum or tank disposal identified during historical aerial photo analysis of fill area boundaries. Magnetometer measurements will be made at locations determined by superimposing a 50 ft by 50 ft grid on the fill areas. Magnetometer measurement points will be located in the field by using known points such as buildings, roads, or other cultural features or by using GPS.

Site	Grid Size	Grid Spacing	Measurements
G	400' x 600'	50' x 50'	96
H	400' x 800'	50' x 50'	128
I	400' x 1,200'	50' x 50'	192
L	200' x 200'	50' x 50'	16
N	300' x 300'	50' x 50'	36
	Total number of measurements		468

Existing information on plume concentration, combined with information from the soil gas survey, will be used in evaluating whether magnetic anomalies indicate the presence buried drums or tanks. Fill areas in Sauget Area 1 were used for disposal of municipal and industrial waste as well as construction debris. Magnetic anomalies are likely to be numerous, intense, and wide spread in the fill areas. It is appropriate to use a screening method to identify those anomalies that should be excavated to evaluate if they are due to buried drums or tanks. Comparing ground water and soil gas concentration highs found at each fill area with corresponding magnetic anomalies at each fill area is a good method for selecting excavation locations within the fill areas, provided ground water and soil gas concentration highs have not migrated beyond the limits of the fill area. Coupling this information with prior geophysical surveys conducted by Ecology and Environment in 1988 and evaluation of historical aerial photograph analysis to identify portions of the fill areas where drums or tanks were placed will allow selection of test trenching locations that focus on areas where tanks or large numbers of drums may be buried. Reportably, the site may contain buried steel drums or debris to depths of 40 ft.

Surface geophysical surveys, which map the distribution of the strength of the earth's magnetic field, have been proven useful in evaluating shallow and deep subsurface conditions at environmental sites. These geophysical surveys have been used to successfully locate buried objects containing magnetically susceptible materials (*i.e.*, iron and nickel metals). The ability of geophysical equipment to locate buried objects is, for the most part, dependent on the strength and orientation of the magnetic anomaly associated with the buried objects, the strength and natural variation of the earth's magnetic field in response to local geology, and the influence of man-made surface features (such as power lines, buried utilities, vehicles, electric motors, etc.) which may interfere with the collection of data.

By comparing the known surface and geological conditions to a magnetic survey map that includes mapped surface feature interferences, and understanding possible geologic background effects, it is possible to identify the location of suspicious subsurface features which may represent buried tanks or drum disposal areas.

Method. A geophysical survey of the site's magnetic field will be completed utilizing a total field magnetometer. The total field magnetometer measures the total strength of the site's magnetic field regardless of the orientation of the magnetic lines of force. The proposed field method involves the collection of magnetic data along pre-established profile lines. During the performance of the geophysical survey, data for the preparation of a field map will be collected. These data will include the total magnetic field strength at each data station, the location of physical site conditions (*i.e.*, streams, ditches, low areas, etc.), and the location of potential surface interferences (*i.e.*, vehicles, overhead power lines, etc.).

A correction for diurnal and micopulsation time variations is not necessary because the site and anticipated anomalies are relatively small in area (less than 1 sq mi), and subsurface anomalies from buried objects of interest should be relatively large (greater than 100 gammas).

A map showing the distribution of magnetic field strength over the five sites will be compiled and compared with the observed field conditions (including the location of known interfering objects such as vehicles, overhead power lines, and surface debris). By comparison, those magnetic anomalies which cannot be explained by observed site conditions will be presumed to be a result of buried subsurface material (*i.e.*, drums, tanks, metal debris, etc.). The depth of detection for suspect objects (such as steel drums) may vary according to orientation, method of manufacture and condition, and numbers present. Steel drums, such as those suspected to be present at this site, may be detected to depths of 40 ft.

Study area definition and measurement spacing. The area of the properties to be surveyed will be evaluated in the field. However, a general area for each survey area has been delineated and provided on a site plan (Figure 1). The study area consists of five site areas described above.

Overall site dimensions for the area will be adjusted based upon the findings of the source area boundary delineation activities discussed in section 5.1.

5.4.2. Field procedures

The following field equipment and procedures will be employed during this geophysical investigation.

Equipment. A Geometrics 858 Cesium or a Geometrics 856AX Total Field Magnetometer will be used to collect the field data. Field procedures and operation of the instruments will be in accordance with the recommended manufacturer's field procedure and application manual.

Calibrated field survey equipment consisting of marked survey line, tape rulers, highway danger cones, and marked wooden stakes will be utilized to establish measurement locations.

Preliminary testing and early termination procedures. The magnetometer has an internal startup test and check program which performs a diagnostic check of the battery and electronic circuitry. The unit will issue a warning statement if all components do not perform within the designed specifications. The magnetometer will not operate if the internal system check is out of compliance.

Instrument calibration and quality control procedures. The magnetometer will be calibrated to provide approximate value based on the established magnetic intensity for the region. The assumed magnetic field intensity for the site area is 51,000 gammas (based on the 1973 US Navy Map in: Applications Manual for Portable Magnetometers, Breiner, 1973). The calibration procedure is explained in the appropriate owner's operation manual and will vary between instrument models. The precise value for the intensity of the earth's magnetitic field at the site is not necessary to identify the location of buried drums.

Following the calibration of the instrument, a field check of the magnetometer readings will be conducted. Here, the instrument is held motionless and ten readings are recorded. Variations in the recorded value of + or - 1 gamma is acceptable. Adjustment in the height of the magnetometer sensor may be necessary to reduce the interference from surface debris; however, for the purpose of this investigation, a standard sensor height of 2 m will be assumed.

A continuous quality control program will be maintained by visually inspecting the data as they are acquired. The data are displayed in a digital format and an electronic beep is used to signal if data collection problems have resulted during the measurement. If a problem is detected, the measurement point will be recollected. The survey will not be continued until the data integrity has been assured.

Field progress/interpretation reporting. Progression of the geophysical survey will be documented in a field notebook. The beginning and ending time of each profile will be noted, and a field map of each completed profile will be maintained to field verify the progress of the survey.

Following the completion of the survey at each site, the magnetometer data will be downloaded twice to a laptop computer. Later, the two databases will be graphically compared to verify that the data download was complete and that the fidelity of the data transferred was protected.

Measurement point/grid surveying. The established survey lines will be marked in the field using a premarked survey line to maintain straight and precise station locations. Profiles will be completed along a straight line with an unobstructed line of sight. The corners of each of the grided areas will be marked with temporary corner stakes to permit the relocation of the measurement points within each site.

Data processing. Following completion of the field phase of investigation and verification that magnetometer data have been successfully transferred to the computer, the following data processing will be performed:

- A graphical review of data will be performed to compare the duplicate databases for completeness and fidelity.

- Cartesian coordinates corresponding to the map location of each measurement point will be assigned to the appropriate magnetometer reading.

- A map display of these data will be produced showing the location of the measurement points and the corresponding magnetometer reading. This map will be produced using AutoCAD Revision 14.

5.5. Buried drum and tank identification - test trenches

5.5.1. Rationale/design

If no excavation location criteria other than the presence of a magnetic anomaly is used to evaluate whether an excavation is appropriate, disturbance of a significant portion of each fill area is likely to result. Excessive trenching could result in unacceptable risks to the community, on-site workers, and the environment at sites that currently appear to be stable.

Test trenches to confirm the presence of buried drums or tanks will be conducted at Sites G, H, I, L, and N. Site G is a fill area stabilized by USEPA Region V in an emergency response that solidified organic wastes, placed a temporary soil cover the site, and controlled site access by installation of a fence. Recent inspection indicates the site is still stable. Site H is a grass field at the intersection of two major roads, Queeny Avenue and Falling Springs Road. It is across the street from the Cahokia Village Hall. Recent inspection indicates the site is stable with a vegetative cover and no wastes exposed at the surface. Commercial buildings and a self-storage facility are located on the site. Site L is located in a vegetated field and appears stable. Site N is located at the rear of a former construction company site that is now occupied by what appears to be a sign company, based on the large amount of sign installation and maintenance equipment parked in the parking along Falling Springs Road. The stability of Site N could not be assessed because it was not visible from publicly accessible areas. Evidence of site clearing across the entire parcel was readily discernible from Falling Springs Road.

Test trench locations will be identified using a combination of magnetic anomalies, aerial photograph analysis, and soil gas and ground water data. Test trenches will be conducted to evaluate the presence of buried drums or tanks at the sites. One test trench will be conducted at the largest magnetic anomaly found at each site that coincides with drum/tank disposal locations identified by historical aerial photograph analysis, an area of high VOC concentration in soil gas, an area of high ground water concentration identified in the 1998 Ecology and Environment Sauget Area 1 Data Report, or major magnetic anomalies report in the 1988 Ecology and Environment Report "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois". Care will be taken not to place major emphasis on the comparison of historical ground water concentrations and magnetic anomalies due to the extent of historical industrial ground water pumping in the area. Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums, which will be removed provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using GPS and recorded for future reference in the event drum removal is appropriate. Recovered drums will be overpacked and stored pending disposal.

Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste and contaminated soil in bulk containers at a controlled-access, fenced, investigation derived waste storage area to be constructed north of Judith Lane adjacent to Dead Creek. Overpacked drums will also be stored at this facility. Drum and waste storage may be indefinite if they contain materials that can not be accepted by off-site disposal facilities, e.g. dioxin. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching to remove buried drums or tanks is an activity that should be done, if necessary, as part of a carefully planned removal action or when a remedy is implemented. Solutia is very concerned about the safety of workers, the community, and the environment during test trenching and drum removal activities. One release to the atmosphere, which sent five workers to the hospital, occurred during an investigation conducted in Creek Segment A. During World War II, the US government built and operated the Chemical Warfare Plant on 15 acres located in Monsanto's W.G. Krummrich plant. Solutia does not know what chemicals were produced by this facility. It is quite likely that raw materials, waste materials, and finished product from the US government's Chemical Warfare Service plant could be present in the fill areas located in Sauget Area 1. For this reason, Solutia believes intrusive activities at Sites G, H, and I to identify buried drums and tanks should be kept to an absolute minimum, if they are conducted at all. With the inherent danger to workers, the public, and the environment associated with drum removal activities, limited ground water downgradient migration of constituents at Sites G, H, and I and no downgradient ground water users, drum and tank removal during site investigation does not seem appropriate. If large numbers of intact drums are encountered and significant downgradient migration of constituents could occur if they were left in place until a remedy could be implemented, a carefully planned and executed removal action to stabilize the situation could be appropriate.

5.5.2. Field procedures
Anomaly test trench locations will be selected in the field based upon the parameters outlined in section 5.5.1 above, and with the concurrence of the USEPA Region V or its designee. To complete the anomaly test trenches, a track-mounted or wheel-mounted hoe will be utilized. As the depth to the top of buried anomalies is not anticipated to be up to 40 ft below grade, a smaller piece of equipment may be utilized for these anomaly test trenches compared to the trenches completed under section 5.1 to delineate the fill area boundaries for the sites. Trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow OSHA rules for excavations. A PID, an explosimeter, and a RAM will be used on a continuous basis to monitor the anomaly test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system. Anomaly test trenches will be advanced until evidence as to the source of the anomaly is found or to a maximum depth of 40 ft, where possible. Should ground water infiltration and/or poor soil stability result in the inability to complete a test trench to 40 ft, the trenching will be terminated at that location. No accommodations will be made to dewater test trenches or manage ground water during excavation activities due to the need to minimize the generation of investigation-derived wastes.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 mil. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. If intact drums are found during anomaly test trench completion, they will be removed, over-packed, and stored in an area to be designated in accordance with the requirements of 29 CFR 1910.120(j). For planning purposes, it is anticipated that up to ten over-packs will be necessary per site and that one day of anomaly test trenching will occur at each of the five sites. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed. Handling of investigation-derived wastes from these activities is discussed in Chapter 9.

5.5.3. Documentation

During anomaly trenching activities, a representative of O'Brien & Gere will complete a descriptive log for each anomaly test trench completed. At a minimum the following information will be included in the log:

- The date, time, weather conditions, equipment, and personnel on-site
- The total depth, length, and width of the anomaly test trench
- The depth and total thickness of distinct soil or lithologic units encountered
- A description of any waste excavated, as well as the identification of the source of the material, where possible
- PID, explosimeter, and RAM readings.

Additionally, the location of the anomaly test trenches will be laid out on a plan of the site. Digital photographs will be taken of the anomaly test trenches, the anomaly test trench walls, and any waste materials or drums excavated. The number and location of each photograph will be identified on the field log for each anomaly test trench.

5.6. Ground water sampling

Ground water samples will be collected in the alluvial aquifer and bedrock at the fill areas, in the alluvial aquifer downgradient of the fill areas, and in shallow ground water and domestic wells adjacent to Dead Creek. The purpose of this sampling is to define current ground water quality conditions at the source areas, to define the extent of migration away from the source areas, and to provide information for the human health risk assessment (construction/utility worker exposure, vapor intrusion into buildings, and residential use of ground water from shallow wells for lawn and garden watering). The Human Health Risk Assessment Work Plan is in Volume 1B.

5.6.1. Degree of hazard and mobility of COCs

Sample number, sample coordinates, and organic and inorganic constituents detected in ground water during past investigations of Sauget Area 1 will be compiled into a GIS-compatible data base, along with data from the EE/CA and RI/FS SSP. Frequency of detection, and average, maximum, minimum, and 95% confidence interval concentrations will be compiled for each detected constituent. Constituent mobility and hazard will be assessed during the human health risk assessment (Volume 1B Human Health Risk Assessment of the SSP).

5.6.2. Recharge and discharge areas

Ground water conditions in the American Bottoms have been studied extensively by the Illinois State Water Survey, Illinois State Geological Survey, and the U.S. Geological Survey. Information from these studies will be used to define recharge and discharge areas.

Experience at Site R and information from published reports on the American Bottoms aquifer indicate that ground water flow patterns in the study area are primarily controlled by the Mississippi River and, to a lesser degree, by Dead Creek. Both drainages run north/south, and ground water will flow toward them in an east/west direction. For ground water to flow from Sites G, H, I, and N to residences located south of these sites, a strong, local perturbation of the flow system would be needed, for example a high capacity pumping well. Plumes associated with Sites G, H, I, and L, as mapped by Ecology and Environment in 1998 (Appendix A of the SSP), do not indicate distortion of the plumes toward the residences on Walnut Street and Judith Lane. Intermittent pumping of domestic wells for gardening or lawn watering is unlikely to stress the aquifer enough to cause COCs to migrate 500 ft cross gradient. Evaluation of historical data, as described in section 5.6.3, will determine if high capacity industrial pumping occurred southwest of Site H.

To address USEPA Region V concern of a southwesterly flow direction from the source areas to the residential areas south of Judith Lane and west of Dead Creek, ground water samples will be collected at three locations on a transect running from Site G to Judith Lane.

5.6.3. Regional and local flow direction and quality

Ground water conditions in the American Bottoms have been studied extensively by the Illinois State Water Survey, Illinois State Geological Survey and the U.S. Geological Survey. Information from these studies will be used to define regional and local flow direction and quality. Dead Creek data compiled by Ecology and Environment in 1998 will be integrated into this evaluation.

As directed by USEPA Region V, ground water flow conditions at the source areas will be evaluated by installing nine piezometer clusters at the locations shown on Figure 7. Each piezometer cluster will consist of three small-diameter wells completed in the shallow, intermediate, and deep portions of the alluvial aquifer. Water levels in each well will be measured quarterly for one year to define seasonal fluctuations in water level elevations. Water levels in existing wells will also be measured. Water level elevation maps will be prepared for each quarterly measurement round and included in the SSP Data Report.

5.6.4. Local uses of ground water

State, county, city, and village records will be searched to identify potential ground water users along Dead Creek. Domestic wells identified by Ecology and Environment are summarized below:

Owner	Street Address	Water Use	Depth
Allen	101 Walnut Street	Greenhouse	17'
Ballet	3300 Falling Springs Road	Residential	20'
Wright	100 Judith Lane	Residential	---
Settles	102 Judith Lane	Residential	---
Schmidt	104 Judith Lane	Residential	49'
McDonald	109 Judith Lane	Residential	---
Lyerla	118 Edwards Street	Residential	---
Hayes	22 Cahokia Street	Residential	---
Baumeyer	24 Cahokia Street	Residential	---

It is important to note that Cahokia and Sauget are served by a public water supply, and that these and other homes in the area are served by municipal water supply system.

5.6.5. Horizontal and vertical distribution of COCs

Ecology and Environment (1998) defined the areal extent of VOCs and SVOCs in shallow ground water at Sites G, H, I, and L. These plumes have migrated several hundred feet downgradient from disposal sites that were used from the 1930s to the 1970s. Plume shape indicates VOC and SVOC migration toward the Mississippi River, which is the discharge point for the American Bottoms aquifer. Ecology and Environment did not collect information on COC distribution in the intermediate and deep portions of the aquifer.

Aquifer saturated thickness in the study area is on the order of 80 to 100 ft, perhaps more. A vertical ground water sampling interval of 20 ft would result in four to five ground water samples per sampling station. A vertical sampling interval of 5 ft would result in sixteen to twenty samples per sampling station. Since the fill areas are 30 to more than 50 years old, the aquifer is thick, highly permeable, and homogeneous, and experience with similar hydrogeologic conditions indicates that leachate migration from these areas should produce plumes with a vertical dimension of more than 5 ft. Under these conditions, plumes are likely to have a vertical dimension of at least 20 ft thick, if not more. For this reason, a vertical sampling interval of 20 ft is considered appropriate. However, in order to address USEPA Region V concerns about adequate characterization of the plumes, vertical ground water samples will be collected every 10 ft.

5.7. Fill areas ground water sampling

5.7.1. Rationale/design

As directed by USEPA Region V in its March 19, 1999 comments on the SSP, ground water concentrations at the source areas will be evaluated by sampling existing Ecology and Environment wells (Appendix B of the SSP) EE-01, EE-02, EE-03, EE-04, EE-05, EE-12, EE-13, EE-14, EE-15, EE-20, EEG-101, EEG-102, EEG-103, EEG-104, EEG-105, EEG-106, EEG-107, EEG-108, EEG-109, EEG-110, EEG-111, and EEG-112. Each well will be located, checked for integrity of surface seals, checked for non-aqueous-phase liquid (NAPL), plumbed for depth and matched against construction records, redeveloped to remove accumulated fine-grained materials and promote ground water entry into the well and sampled to provide data on current ground water conditions at the source areas. If some or all of these wells no longer exist or can not be sampled, ground water samples will be collected at the depth of the former screened interval using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™ or equivalent sampling technology and low-flow sampling techniques.

The location and purpose of sampling these wells are summarized below:

Site	Source Area or Downgradient Well	Shallow Ground Water Background Well	Screen Depth (ft below ground surface)
G	EE-05		18-23
	EEG-101		18-23
	EEG-102		16.5-21.5
	EEG-104		19-24
	EEG-106		18-23
	EEG-107		23-28
	EEG-112		21-26
H	EE-01		28-33
	EE-02		18-23
	EE-03		27-32
		EE-04	18-23
	EEG-110		18-23
I	EE-12		28-33
	EE-13		23-29
	EE-14		32.5-37.5
	EE-15		24-29
		EE-20	23-28
L	EEG-103		16.5-21.5
	EEG-105		No construction log
	EEG-109		17.5-22.55
South of G	EEG-111		No construction log
		EEG-108	24-29

Background ground water samples will be obtained from the middle and bottom of the aquifer at the location of existing wells EE-04, EE-20, and EEG-108 as described in section 5.16.

Number of Ground Water Samples 19

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling these wells provides more information that is needed to evaluate current conditions at the source areas or to provide information for the human health risk assessment. Collecting samples in the core of the plumes at Sites G, H, I, and L using existing wells EEG-107, EE-02, EE-16, and EEG-109 will provide adequate information for characterizing conditions at the source areas. If these wells do not exist, or are unusable, existing wells EEG-106, EE-01, EE-14, and EEG-103 could be used as alternative sampling locations at Sites G, H, I, and L, respectively.

Table 4 is a sample and analysis summary for this activity.

5.7.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.7.3. Field procedures

Ground water monitoring well redevelopment (if required). The objective of ground water monitoring well redevelopment is to clear the well of accumulated sediments, when 10% or more of the well screen has been occluded by sediment, so that representative ground water samples may be collected. The accumulated sediments need to be re-suspended in the water column in order to be removed. A variety of techniques can be used to re-suspend the sediments. Some of the common methods that can be used to re-suspend sediments include using a surge block, injection of air into the water column of the well, or using a bailer. Once the sediment is re-suspended, the water and sediment can then be removed from the well using a submersible pump, an air bladder pump, or a bailer. Redevelopment will be considered to be complete when the fine-grained materials have been removed.

For the existing ground water monitoring wells to be sampled for this project, the preferred method for redevelopment will be to use a surge block to re-suspend the sediments, and a submersible pump to remove the water and suspended sediments. However, if this method is ineffective, a combination of one or more of the methods indicated above will be used. The following procedures will be used when redeveloping an existing well.

- Place a clean, plastic drop cloth on the ground around the well to be redeveloped.

- Unlock the protective well cover and remove the well cap.

- Check the well for NAPL using an interface probe, as outlined in the water level measurement section below.

- Measure the depth to ground water and/or NAPL to the nearest hundredth of a foot.

- Measure the total depth of the well to the nearest hundredth of a foot. Note whether the bottom of the well feels hard or soft.

- Compare the total measured depth of the well to the record installed depth of the well, if available.

- If the comparison shows greater than 10% occlusion of the well screen, proceed with redevelopment. For wells that have no recorded installed depth and have a soft bottom, assume redevelopment will be required.

- Attach the decontaminated surge block to the appropriate lengths of pole section and push the surge block to the bottom of the well.

- Pull and push the surge block up and down to agitate the water and suspend the sediments in the well.

- Once sufficient re-suspension has occurred, pull the surge block out of the well.

- Attach an appropriate length of polyethylene tubing to a submersible pump, and lower the pump to near the bottom of the well, out of sediment that may be remaining in the bottom of the well.

- Place the discharge end of the tubing such that purged water will be collected in a 55-gal drum.

- Turn on the pump and adjust the flow rate to pump at a sufficiently high rate to allow the sediments to be removed without causing the pump to clog.

- Continue pumping until relatively sediment-free water is obtained.

- Remove the pump and allow the well to recover for half an hour. Re-measure the total well depth. If the measured depth indicates 10% or more occlusion, repeat steps 8 through 14. If the measured depth indicates less than 10% well screen occlusion, disconnect the tubing from the pump and place into the appropriate waste container. Dismantle the surge block and pole connectors for decontamination. Close and lock the protective casing. And, pick up and appropriately dispose of plastic sheeting and other disposables into the appropriate waste container. Close and properly label the 55-gal drum(s).

- Decontaminate the pump, wiring, and surge block system using the steam cleaner.

- Note in the field log book the approximate number of gallons of water removed during redevelopment of each well.

Pre-sampling procedures. As part of a sampling event, the following steps will initially be taken by personnel responsible for sampling:

- Obtain appropriate containers for sample collection. Containers will be provided by the laboratory performing the analyses.
- Examine sampler, containers, and preservatives; contact laboratory immediately if problems are found.
- Confirm sample delivery time and method of sample shipment with the laboratory.
- Assemble and inspect field equipment to be used for sample collection; verify that equipment is clean and in proper working order.
- Calibrate field instruments and/or meters to manufacturers' specifications. Conductivity, pH, and turbidity meters will be calibrated to known calibration standard solutions. Re-check calibration prior to the start of each day and after four hours of use. Calibration activities will be recorded on the ground water sampling log (Appendix E) and in the field notebook.
- Perform NAPL interface probe function test in accordance with section 6.1.11 of the Project QAPP.
- Establish well location and well identification.
- Obtain necessary keys for wells or gates.
- As feasible, begin sampling procedures at monitoring wells that are least impacted and proceed to those that historically have been impacted. A review of previous analytical data will be required prior to sampling.
- Examine each well for damage, tampering, erosion around the well casing, etc., and note on respective field log sheet.
- Place clean plastic sheeting around well to provide a barrier between the surrounding ground surface and sampling equipment used.
- Put on a new pair of disposable gloves.

- Open well cap and make a visual check down the casing and note the condition of the well casing and whether a permanent ground water level reference point has been established on the casing. Note on respective field log sheet.

- Perform ambient air monitoring for hazardous conditions on a continuous basis following opening of the well using a PID and an explosimeter. Record readings in the field notebook.

Water level measurements. Prior to initiating ground water sampling, water elevations will be measured in each of the wells on-site. Ground water level measurements will be collected as follows:

- A pre-cleaned, electric water level or NAPL interface probe will be used to measure the depth to water from the top-of-casing reference point and/or to check for NAPLs in the water column, where applicable. Record the depth of water and/or NAPLs, as applicable. This procedure will also be used to measure the depth of the well. Measurements will be made to the nearest 0.01 ft.

- After obtaining the water level, the volume of water within the well will be calculated.

- Decontaminate the water level and NAPL interface probe used in the well by thoroughly scrubbing with an Alconox® and potable water wash. Rinse with potable water, and then rinse twice with distilled water.

Record keeping. Prior to initiating the well purging process, the following information will be recorded in a field notebook and on the ground water sampling logs (Appendix E):

- Well number
- Day, date, and time
- Weather conditions
- Condition of the well and the surrounding area
- Sampling team members
- Instrument calibration information (before and after)
- Water level prior to purging
- Depth to the bottom of the well
- Volume of water to be purged
- Physical properties of evacuated water: color, odor, turbidity, presence of non-aqueous phase liquids

- Deviations from planned sampling methodology
- Ambient air monitoring readings.

Well purging. Prior to sampling, the wells will be purged to remove the standing water column from the well casing. A well volume of water is calculated using the following formula: $V = \pi r^2 h(7.48)$ where

V = Standing water volume in gallons to be purged

r^2 = inside radius of well in feet, squared

h = Linear feet of standing water in the casing.

One well volume will be calculated so field personnel know when to perform field measurements. Such measurements are performed after the removal of each well volume.

In ground water systems, naturally occurring metals tend to adsorb to the surfaces of solids. The level of adsorbance depends on the pH of the soil and water. The concentration of metals in dissolved form, therefore, is limited by this adsorption and by the metals' low solubility. Sediment in water is likely to have metal ions adsorbed to its particles, which analytical methods may not be able to differentiate from metal ions dissolved in the water. Ground water samples that contain sediment, therefore, may yield analytical results that do not represent the concentration of metals in the ground water itself.

Moreover, the transport of sediment is generally not due to the natural flow of ground water, but is induced by the sampling. Samples that are collected to be analyzed for metals should exhibit low turbidity, and they are generally filtered, therefore, to remove sediment. When possible, low turbidity samples should be obtained without filtering. Therefore, a low-flow peristaltic pump will be used at an appropriate flow rate of 100 ml/min for purging and to collect ground water samples. Should ground water depths exceed the suction head limitations of a peristaltic pump, a micro-bailer will be utilized for sample collection. A turbidity meter will be used to monitor turbidity during sampling. Following the extraction of each well volume, turbidity will be monitored in the field. Additionally, pH, conductivity, and temperature will be measured and recorded after each well volume removed. Samples will be collected when turbidity levels are below 5 nephelometric turbidity units

(NTU). Should a turbidity level of 5 NTU be unachievable after 2 hours of purging, the samples will be collected and the turbidity recorded.

The procedures for well purging are described as follows:

- Prepare the pump for operation. Follow the manufacturer's directions.

- Lower the pump to the screened zone of the well.

- Pump the ground water into a graduated pail. Continue pumping until the turbidity reading is at or below 5 NTU or the well is pumped dry. Lower the pump's intake as necessary.

- If the well is pumped dry, allow sufficient time for the well to recover before proceeding. Record this information on the ground water sampling log.

- In addition to the turbidity readings, in wells which exhibit sufficient recharge, also collect pH, conductivity, and temperature measurements. Three consecutive measurements should be within the following criteria:

  - ±0.25 units for pH
  - ±10% for specific conductivity
  - ±1 C° for temperature.

  Record this information on the ground water sampling log.

- Discharge the water removed during purging or possible decontamination procedures into 55-gal drums for disposal.

Sampling procedure. Each well will be sampled according to the following procedures:

- Remove the sample containers from their transport containers, and prepare the bottles for receiving samples. Inspect labels for proper sample identification. Sample containers will be kept cool with their caps on until they are ready to receive samples.

- The pump will be situated within the screened interval of the well so as to take into account past sampling activities and the fact that domestic well screens have been reported from 15 to 25 ft below ground surface. Should the water level in the well drop during pumping, the pump intake will be adjusted to maintain flow.

- Fill sample containers for VOC samples prior to filling other sample containers.

- Fill remaining sample containers.

- If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until filled. Sample containers will be preserved as described in the QAPP.

- Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius using ice. Samples must not be allowed to freeze.

- Begin the chain-of-custody record.

- Record the physical appearance of the ground water observed during sampling on the ground water sampling log or in the field notebook.

- Replace the well cap and lock the well protection assembly before leaving the well location.

Sampling equipment decontamination.

- Brush-wash reusable sampling equipment in a bucket or tub using a trisodium phosphate (TSP), or other commercial detergent, solution (2 lb of TSP per 10 gal of clean water). Completely brush the entire exterior surface of the article undergoing decontamination. Wash interior wetted surfaces as required. Rinse the item with copious quantities of potable water, followed by a distilled water rinse.

- Rinse reusable sampling equipment used to collect environmental media for metals analysis in a dilute nitric acid solution, followed by a distilled water rinse.

- Air-dry sampling equipment on a clean, non-plastic surface in a well ventilated, uncontaminated environment. If the sampling device is not to be used immediately, wrap it in aluminum foil and place it in a plastic bag or storage container.

- Contain rinse waters in a plastic tub with a lid. Empty the contents of this tub daily into a 55-gal drum located at the investigation-derived waste storage area.

- Sample tubing will be disposed after each use, and new tubing will be used for each location.

Sample control and chain-of-custody.

- For proper identification in the field and proper tracking in the laboratory, samples will be labeled in a clear and consistent fashion, as outlined in section 6.1.2.

- Sample labels will be waterproof or sample containers will be sealed in plastic bags.

- Field personnel will maintain a sampling log sheet.

- The sampling log sheets will contain sufficient information to allow reconstruction of the sample collection and handling procedures at a later time.

- Each ground water monitoring well will have a corresponding sample log sheet which includes:

  - Sample identification number
  - Well location and number
  - Date and time
  - Sampler's name
  - Sample type (composite or grab)
  - Analysis for which sample was collected
  - Field parameters, including pH, temperature, and conductivity
  - Method of preservation
  - Additional comments as necessary.

- Each sample will have a corresponding entry on a chain-of-custody record. The record will include the items listed in section 6.1.3.

Following completion of the chain-of-custody record, the samples will be packaged for transport to the laboratory. A completed chain-of-custody document will be provided for each shipping container. The field sampler will make a copy of the chain-of-custody document to keep with the field notebook, and include the original chain-of-custody document in an air-tight plastic bag in the sample cooler with the associated samples. Sample packaging and shipping procedures are described in Chapter 8.

Purge water. Purge water generated from ground water sampling activities will be contained in 55-gal drums and transported to the liquid waste disposal container.

Disposal of investigation-derived wastes. During the subsurface investigation, subsurface soils, ground water, decontamination water, and general waste (plastic, paper, etc.) will be generated. Subsurface soils, ground water (development and purge water), and equipment decontamination water will be temporarily contained in drums and transferred to waste containers. General waste will be contained in plastic bags and disposed in a general refuse container.

5.8. Alluvial aquifer ground water sampling

5.8.1. Rationale/design

As directed by USEPA Region V, one alluvial aquifer saturated-thickness sampling station will be located at the ground water concentration high at Site H and, one alluvial aquifer saturated-thickness sampling station will be located at the ground water concentration high at Site I (Figure 7). If available records or aerial photographs indicate the location of dredge spoil from Creek Segment A, the Site I alluvial aquifer saturated thickness sampling station will be placed at the location of this spoil instead of at the ground water concentration high, as directed by the USACE. Ground water samples will be collected at these locations in order to evaluate the vertical extent of organic and inorganic constituents migrating away from Sites H and I.

Telescoping surface casing will be installed to depths of 5 ft and 20 ft below the fill material in order to minimize carry-down of site-related constituents during ground water sample collection. This casing will be grouted from the bottom up after completion of sampling.

Ground water samples will be collected every 10 ft from bottom of the surface casing to bedrock, which are assumed to be 60 and 100 ft deep, respectively, using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques.

Number of Ground Water Samples 8

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 5 is a sample and analysis summary for this activity.

5.8.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.8.3. Field procedures

Field procedures for collection of alluvial aquifer ground water samples will follow procedures for collection of ground water in the fill areas as described in section 5.7.3.

5.9. Downgradient alluvial aquifer sampling

5.9.1. Rationale/design

Sites G, H, and L. The horizontal and vertical extent of organic and inorganic constituents migrating away from Sites G, H, and L and toward the Mississippi River will be evaluated by collecting samples at three sampling stations located along a transect between the maximum shallow ground water concentrations at Site G and Illinois Route 3 (Figure 7). Ground water samples will be collected every 10 ft from the water table to bedrock, which is assumed to be 100 ft deep, using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques.

Experience at other sites indicates that push sampling technologies such as Geoprobe™ can reach depths of 60 ft. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe™ sampler or equivalent sampling technology can not penetrate to the required sampling depth, MicroWells™ will be used to collect ground water samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 ft can be achieved. If the required sampling depths can not be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Number of Ground Water Samples 30

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Site I. The horizontal and vertical extent of organic and inorganic constituents migrating away from Site I and toward the Mississippi River will be evaluated by collecting samples at three sampling stations located along a transect between the maximum shallow ground water concentrations at Site I and Illinois Route 3 (Figure 7). Ground water samples will be collected every 10 ft from the water table to bedrock, which is assumed to be 100 ft deep, using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques.

Number of Ground Water Samples 30

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Areas southwest of Sites G, H, I, and L. The horizontal and vertical extent of organic and inorganic constituents migrating away from Sites G, H, I, and L and moving in a southwesterly direction will be evaluated by collecting samples at three sampling stations located along a transect between the maximum shallow ground water concentrations in Site G and Illinois Route 3

(Figure 7). Ground water samples will be collected every 10 ft from the water table to bedrock, which is assumed to be 100 ft deep, using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques.

Number of Ground Water Samples 30

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Dioxin sampling. Presence or absence of dioxin in ground water migrating away from Sites G, H, I, and L will be evaluated by analyzing samples from the shallow (20 ft below ground surface), intermediate (60 ft below ground surface), and deep (100 ft below ground surface) portions of the alluvial aquifer at each of the three sampling stations downgradient of Sites G, H, and L; each of the three sampling stations downgradient of Site I; and each of the three sampling stations southwest of Sites G, H, I, and L. Samples will be collected concurrently with the VOC, SVOC, metals, mercury, cyanide, PCB, pesticide, and herbicide samples described above.

Number of Ground Water Samples 27

Analyses	Dioxin	USEPA Method 8290

Table 6 is a sample and analysis summary for this activity.

5.9.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.9.3. Field procedures

Push point. Using the hydraulic push system of a Geoprobe™, or similar unit, a mill-slotted or stainless steel screen point will be pushed to the water table. A high-density polyethylene (HDPE) (or Teflon®-lined or Teflon®) tube will be inserted into the center annular space to approximately one to one and one-half feet above the bottom of the screen. An appropriate length section of flexible fluoropolymer tubing will be attached to the HDPE tubing using a barbed connector. The flexible tubing will be connected through the head of the peristaltic pump. The open end of the flexible tubing will be located so it can discharge into a purge water container (5-gal bucket). The peristaltic pump will be turned on at an approximate flowrate of 100 ml/min. The purging will continue for 60 minutes. As the 5-gal discharge bucket fills, it will be replaced with an empty bucket, and the full bucket will be emptied into a 55-gal drum. At the end of 60 minutes, the pH, conductivity, temperature, and turbidity will be measured and recorded in the field sampling notebook. If the turbidity is greater than 5 NTU, purging will continue. Once the turbidity is at or below 5 NTU or 2 hours have elapsed, ground water samples will be collected into labeled, pre-preserved (where necessary), laboratory-provided containers. Sample containers for VOC analysis will be filled first. Collected samples will be placed on ice in a cooler, and chain-of-custody procedures will be initiated. The fluoropolymer tubing will be disconnected from the peristaltic pump. The HDPE tubing will be pulled from the center annular space. The flexible tubing and HDPE tubing will then be discarded into plastic trash bags. Clean sections of push rods will be connected, the sampling point will be advanced 10 ft, and the sample collection method will be repeated.

MicroWell™. It is anticipated the above sampling method will be used as feasible. However, based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered which will stop the Geoprobe™. Should this occur, MicroWells™ would be installed to use as the sample collection point. The MicroWells™ will be hydraulically pushed to the appropriate depth, and the sampling procedure described above, beginning with inserting the tubing through the annular space, will be followed. Once the sample is collected, the MicroWell™ will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced 10 ft further in the same hole. This procedure will be repeated until reaching bedrock.

Should MicroWell™ installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which ground water will flow. A submersible Grundfos Rediflow™ pump will be placed through the center of the augers to approximately two feet from the bottom. The pump will have the appropriate length of HDPE tubing attached. The tubing will discharge to the 5-gal bucket at before. The sample will be collected from the tubing, filling the VOC containers first. Once all the samples are collected, the augers will be advanced 10 ft; a new, clean section of tubing will be attached to the pump; and additional samples will be collected. This procedure will be repeated to bedrock. All Geoprobe™, MicroWell™, or Waterloo Profiler™ holes or casings will be sealed with grout from the bottom up after completion of sampling at each location. A PID, an explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

Sampling equipment decontamination.

- Brush-wash reusable sampling equipment in a bucket or tub using a trisodium phosphate (TSP), or other commercial detergent, solution (2 lb of TSP per 10 gal of clean water). Completely brush the entire exterior surface of the article undergoing decontamination. Wash interior wetted surfaces as required. Rinse the item with copious quantities of potable water, followed by a distilled water rinse.

- Rinse reusable sampling equipment used to collect environmental media for metals analysis in a dilute nitric acid solution, followed by a distilled water rinse.

- Air-dry sampling equipment on a clean, non-plastic surface in a well ventilated, uncontaminated environment. If the sampling device is not to be used immediately, wrap it in aluminum foil and place it in a plastic bag or storage container.

- Contain rinse waters in a plastic tub with a lid. Empty the contents of this tub daily into a 55-gal drum located at the investigation-derived waste storage area.

5.9.4. Documentation

A field notebook will be kept for the alluvial aquifer sampling. At a minimum, the notebook will include project name and number; date and time; weather conditions; sampler's name; sample location, pH, conductivity, temperature, PID, explosimeter, RAM, and turbidity measurements; changes in sampling technique; depths of sample collection; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will also be included in the field notebook.

5.10. Bedrock ground water sampling

5.10.1. Rationale/design

As directed by USEPA Region V, three bedrock wells will be installed in the middle of Sites G, H, and I in order to evaluate the vertical extent of organic and inorganic constituents migrating away from these sites. Telescoping surface casing will be installed to depths of 5 ft and 20 ft below the fill material and 5 ft into bedrock in order to minimize carry-down of site-related constituents during ground water sample collection and vertical migration of site-related constituents after completion of sampling.

Bedrock will be cored to a depth of 20 ft below the telescoping casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. A ground water sample will be collected from each core hole.

Sampling locations will be based on the fill area shallow ground water sampling results (section 5.7.1).

Number of Ground Water Samples 3

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 7 is a sample and analysis summary of this activity.

5.10.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.10.3. Field procedures

Mud rotary drilling methods will be used to drill the boreholes to set the telescoping casing and to drill 5 ft into the top of bedrock. Coring will then be accomplished using wireline coring barrels to generate a 2-inch minimum core. Coring will continue for 20 ft into the bedrock. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below. After coring is completed, a ground water sample will be collected from the bedrock core hole. Sampling will be accomplished using a Grundfos Rediflow™ pump, control box, and electrical generator. Sampling will be accomplished following applicable procedures outlined in section 5.7.3. A PID, an explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

Once sample collection is completed, the pump and tubing will be pulled. The tubing will be placed into a plastic trash bag and disposed of in the general waste dumpster. The bore hole will be abandoned by filling the annular space with a cement and bentonite grout from bottom to top. The surface top 2 ft will be restored with soil and seeded. The drill rig will be moved to the decontamination station and steam cleaned. Solids will be placed into a container for transport to the soils disposal collection container.

Sampling equipment decontamination.

- Brush-wash reusable sampling equipment in a bucket or tub using a trisodium phosphate (TSP), or other commercial detergent, solution (2 lb of TSP per 10 gal of clean water). Completely brush the entire exterior surface of the article undergoing decontamination. Wash interior wetted surfaces as required. Rinse the item with copious quantities of potable water, followed by a distilled water rinse.

- Rinse reusable sampling equipment used to collect environmental media for metals analysis in a dilute nitric acid solution, followed by a distilled water rinse.

- Air-dry sampling equipment on a clean, non-plastic surface in a well ventilated, uncontaminated environment. If the sampling device is not to be used immediately, wrap it in aluminum foil and place it in a plastic bag or storage container.

- Contain rinse waters in a plastic tub with a lid. Empty the contents of this tub daily into a 55-gal drum located at the investigation-derived waste storage area.

Decontamination water will be placed into a temporary container and transported to the wastewater disposal container. Investigation-derived wastes, such as disposable gloves, paper towels, plastic sheeting, and Tyvek™ suits (if worn), will be containerized and taken to the general refuse container for disposal.

Method. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. The order and presentation of selection of data are presented below.

The order in which the rock description is to be documented must be observed. Follow the order presented below.

Order of description for lithology.

1. color	9. weathering
2. rock quality	10. surface
3. porosity	11. hardness
4. beds	12. texture
5. thickness	13. grain shape
6. contact	14. sorting
7. foliation	15. mineral components
8. joints	16. rock classification

Abbreviations of the descriptions will conform to the standard abbreviation list. This list is presented below. A word that is not on this list will be spelled out. An initial capital letter will be used for each rock type. Capital letters will be for formation names and rock types.

Punctuation will also be standardized. The following convention will be used for punctuation:

- Comma after each item of description
- Semi-colon between each rock-type description
- No full stops (periods).

In addition, remarks such as *A/A* ("as above"), *same as above, see above,* or *same* are undesirable.

Log order of presentation and selection. The following order will be used to present information on the log:

1. Color
Color (from Munsell Color Chart) of logged interval or mass (sample).

2. Rock quality
The rock quality designation (%RQD) is computed in the following way:

%RQD = 100 x [length of core in pieces ≥4'] ÷
[hole length drilled or attempted (cored)]

Guidelines:

- Measure from the center of natural breaks.
- Exclude joints that dip within 5 degree of core axis.
- Exclude drill breaks. (See criteria for identification of drill breaks.)
- Do not calculate RQD for soft semi-indurate rock or severely weathered rock ("Weathering" is addressed below.)

Scale:

90 - 100	excellent..........................massive
75 - 90	good....................lightly fractured
50 - 75	fair...............moderately fractured
25 - 50	poor.....................highly fractured
0 - 25	very poor.........................sheared

It is appropriate to think of RQD in conditions of equal effect; that is, group the RQD ranges as equivalent to rock type, structural domain, shear zones, and so forth.

Criteria for identifying drilling breaks

- A rough, brittle surface with fresh cleavage planes in individual rock minerals indicates an artificial fracture.

- A generally smooth or somewhat weathered surface with soft coating or infilling materials such as talc, gypsum, chlorite, mica or calcite obviously indicates a natural discontinuity.

- In rocks showing foliation, cleavage, or bedding, it may be difficult to distinguish between natural discontinuities and artificial fractures when these are parallel with the incipient planes of weakness. If drilling has been carried out carefully, then the questionable breaks should be counted as natural features, to make the conservative assumption.

- Depending on the drilling equipment, part of the length of core being drilled may occasionally rotate with the inner barrels in such a way that grinding of the surfaces of discontinuities and fractures occurs. In weak rock types, it may be difficult to decide if the resulting rounded surfaces are present natural or artificial features. When in doubt, the conservative assumption should be made; that is, assume that they are natural.

- It is appropriate to keep a separate record of the frequency of artificial fractures for assessing the possible influence of blasting on the weaker sedimentary and foliated or schistose metamorphic rocks.

The occurrence of impurities is qualified with the following terms:

consolidated, unconsolidated, semi-consolidated round, sub-round, sub-angular, angular, ellipsoidal, spherical.

masses	brecciated	trace remnants
pockets	chaotically intermixed	disseminated throughout matrix
nodules	fine wispy layers	scattered
blebs	stringers	streaks or specks
lenses	subtle network	narrow zones
oolites	chicken wire pattern	
zones	dendritic	
transitions		

3. Porosity

Use the following descriptions: none, medium, moderate, very, pinhole porosity, visual porosity.

4. Beds
Bedding, horizontal or inclined:

planar
mylonitic
folded
contorted
wavy banding

Bedding, beds, cleavage, and foliation:

very thin	1-3 cm (0.4-1")
thin	3-10 cm (1-4")
medium	10-30 cm (4"-1")
thick	30-100 cm (1'-3')
very thick	> 100 cm (>3')

Lamina
laminated: 0.3-1 cm (0.4-0.1")
thinly laminated: <0.3 cm (<0.4")

5. Thickness, laminations, lamella, seams
smooth
broken
irregular
convoluted
up/down criteria

6. Contact
distinct
vague
gradational

7. Foliation
fissile (planar splitting)
non-fissile

8. Joints

planar	irregular break	infilled with
parting planes	scalloped	healed fracture
	conchoidal	mylonitic

Spacing

very thin	1-3 cm (0.4-1")
thin	3-10 cm (1-4")
medium	10-30 cm (4"-1")
thick	30-100 cm (1'-3')
very thick	> 100 cm (>3')

9. Weathering

Fresh Rock fresh; crystals or grains bright; a few joints may show slight staining; crystalline rocks ring if struck with a hammer.

Slight Rock generally fresh; joints stained and may show clay filling if open; staining may extend into rock fabric adjacent to weathered planes; if present, feldspars may be dull and discolored; crystalline rocks ring if struck with hammer.

Moderate Except for quartz, most of the rock mass shows discoloration and weathering; most feldspar is dull and discolored and kaolinitization (alteration to clay minerals) is common; rock gives a dull sound if struck with hammer; rock shows overall loss of strength; potions may be removed with a geologist's pick.

Severe All minerals except quartz discolored or stained; rock fabric still discernible; intergranular or intercrystalline disassociation virtually complete; internal structure essentially that of soil; fragments of strong rock may remain; may be called saprolite.

Complete Rock is decomposed to a soil; fabric not discernible or only barely discernible; quartz may remain as dikes or stringers.

10. Surface

Solid	Contains no voids.
Pitted	Small voids generally restricted to joint surfaces, bedding planes, or other surfaces which provide access for attacking fluids.
Vuggy	Use restricted to solution voids in carbonate rocks and hydrothermally altered rocks; voids may be found throughout the rock face; voids up to 9 inch diameter.
Vesicular	Use restricted to voids in igneous (occasionally metamorphic) rocks, void origin usually due to gas bubbles; voids up to 3 inch average diameter.
Cavernous	Applicable in any rock; voids and channels greater than 9 inch average diameter; voids large enough to cause serious leakage or structural problems.

11. Hardness
The following scale (not to be confused with Moh's scale for hardness of minerals) is used to a rock:

Very hard	Cannot be scratched with knife or sharp pick; breaking of hand specimens require several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty; hard blow of hammer required to detach hand specimen.
Moderately	Can be scratched with knife or pick; gouges or groves to 1/8 inch deep can be excavated by hard blow of point of geologist's pick; hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 inch deep by firm pressure on knife or pick point; can be excavated in small chips to pieces about 1 inch maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point; can be excavated in chips to pieces several inches in size by moderate blows of a pick point; small thin pieces can be broken by finger pressure.

Very soft Can be carved with knife; can be excavated readily with point of pick; pieces 1 inch or more in thickness can be broken by finger pressure; can be scratched readily by fingernail.

12. Texture
American Geological Institute data sheets

fine = <1 mm
medium = 1.5 mm
coarse = >5 mm

13. Grain shape
very angular
angular
subangular
subrounded
rounded
well rounded

14. Sorting (for sedimentary rocks)
very well sorted
well sorted (poorly graded)
moderately sorted
poorly sorted (well graded)
very poorly sorted

15. Mineral components

16. Rock classification
American Geological Institute data sheets.

Accepted abbreviations.

A

about	ABT
above	ABV
abundant	ABDT
accumulation	ACCUM
acicular	ACIC
aggregate	AGG
agglomerate	AGLM
algae	ALG
altered	ALT
amorphous	AMOR
amount	AMT
angular	ANG
anhedral	ANHED
anhydrite	ANHY
anhydritic	ANHYDRIC

apparent .... APR
appears .... APRS
approximate .... APROX
aragonite .... ARAG
arenaceous ...... AREN
argillaceous .... ARG
arkose .... ARK
asphalt .... ASPH
at .... @
average .... AV

B
band .... BND
banded .... BNDD
barite .... BAR
basalt .... BAS
bed .... BED
bedded .... BEDD
bedding .... BEDG
bentonite .... BENT
biotite .... BIOT
bitumen .... BIT
black .... BLK
bleeding .... BLDG
blocky .... BLKY
botryoida .... BTRI
bottom .... BTM
boulder .... BLDR
brachiopod .... BRAC
breccia .... BREC
brittle .... BRIT
bright .... BRI
broken .... BRKN
brown .... BRN
bryozoa .... BRY

C
calcite .... CA
calcareous .... CALC
carbonaceous .... CARB
cavernous .... CAV
caving .... CVG
cement .... CMT
center .... CNTR
cephalopod ...... CEPH
chalcedony .... CHAL
chalk .... CHK
chert .... CHT
chitin .... CHIT
chlorite .... CHL
chloritic .... CHLTC
clastic .... CLAS
clay .... CLY
claystone .... CLYST
clean .... CLN
clear .... CLR
cleavage CLV
cluster .... CLS
coal .... COAL
coarse C
cobble .... CBL
color .... COL
common .... COM
compact .... COMP
conchoidal ..... CONCH
concentric .... CNCN
conodont .... CONO
conglomerate ...... CGL
contact .... CONT
contorted ..... CONTRT
coquina .... COQ
covered .... COV
cream .... CRM
crenelated .... CREN
crevice .... CREV
crinkled .... CRNK
crinoid .... CRIN
crossbedded .... XBEDD
crosslaminated .... XLAM
cross-stratified .. XSTRAT
cryptocrystalline CRPXLN
cryptograined ... CRPGR
crystal XL
crystalline .... XLN
cuttings .... CTGS

D
dark .... DK
dead .... DD
debris .... DEB
degree .... DEGR
dendritic .... DEND
dense .... DNS
determine .... DTRM
detrital .... DTRL
diameter .... DIAM
diatoms .... DIAT
difference .... DIF
disseminated ..... DISM
dolocast .... DOLC
dolomite .... DOL
dolomitic .... DOLIC
dolomoid .... DOLM
drusey .... DRSY

E
earthy .... ETHY
echinoid .... ECH
eliptical .... ELIP
elongate .... ELNG

embedded .... EMBEDD
enlarged .... ENL
epidote .... EP
equivalent .... EQUIV
euhedral .... EUHED
evaporitic .... EVAP
expose .... EXP
extrusive .... EXTRU

F
faceted .... FAC
faint .... FNT
fair .... R
fault .... FLT
fauna .... FAU
feldspar .... FELS
ferruginous .... FE
fibrous .... FIB
figured .... FIG
fine,-ly .... F
fissile .... FISS
flaggy .... FLGY
flake,-y .... FLK,-Y
flinty .... FLTY
floating .... FLTG
fluorescence ..... FLUOR
foliated, -ion .... FOL
foraminifera .... FORAM
formation .... FMTN
fossil .... FOSS
fossiliferous ..... FOSSIF
fracture,-ed .... FRAC
fragment .... FRAG
fresh .... FRSH
friable .... FRI
frosted .... FROS
fusilinid .... FUS

G
gabro .... GAB
gastropod .... GAST
glassy .... GL
glauconite ...... GLAUC
globular .... GLOB
gloss .... GLOS
gneiss .... GN
good .... G
grade .... GRD
grading .... GRDG
grain .... GRN
granite .... GRNT
granular .... GRAN
granule .... GRNL
graptolite .... GRAP
gravel .... GVL
gray .... GRY
graywacke ..... GYWKE
greasy .... GRSY
green .... GREEN
gritty .... GRTY
gypsum .... GYP
gypsiferous .... GYPS

H
hard .... HD
heavy .... HVY
hematite .... HEM
high .... HI
horizontal .... HOR
hornblende .... HBD
hydrocarbon ...... HYDC

I
igneous .... IG
imbedded ...... IMBEDD
impregnated ..... IMPRG
impressions .... IMP
included .... INCL
inclusion .... INCLSN
increase .... INCR
indistinct .... IND
interbedded ... INTBEDD
intercrystalline ... INTXLN
intergranular ... INTGRAN
intergrown .... INTGWN
interlaminated ... INTLAM
interstitial ...... INTSTL
interval .... INTVL
intraformational ... INTRM
intrusion .... INTR
invetebrate ...... INVRTB
iron .... FE
iron Oxides .... FE-OX
ironstone .... FE-ST
irregular .... IREG
iridescent .... IRID

J
jasper .... JASP
jointed .... JTD

jointing .... JTG
joints .... JTS

K

kaolin,-ite .... KAOL

L

laminated .... LAM
large .... LRG
lavender .... LAV
layer .... LYR
leached .... LCHD
ledge .... LDG
lenticular .... LENT
light .... LT
lignite .... LIG
limestone .... LS
limonite .... LMNT
limy .... LMY
lithic .... LITH
lithographic .... LITHG
little .... LTL
long .... LONG
l .... OOSELSE
lower .... LOW
lumpy .... LMPY
luster .... LSTR

M

macro-fossil ... MACFOS
magnetic .... MAGN
magnetite .... MAG
marl .... ML
marlstone .... MRLST
maroon .... MAR
massive .... MASS
material .... MAT
matrix .... MTX
maximum .... MAX
medium .... M
member .... MBR
metamorphic ... METAM
mica .... MIC
micaceous ...... MICAC
microcrystalline .. MICXLN
microfossil .... MICFOS
micrograined .... MICGR
micromicaceous ... MMIC
middle .... MID
mineral .... MNRL
minimum .... MIN
minor .... MNR
minute .... MNUT
moderate .... MOD
mollusca .... MOL
mottled .... MOT
mudstone .... MDST
muscovite .... MUSC

N

nacreous .... NAC
nodule .... NOD
numerous .... NUM

O

object .... OBJ
occasional .... OCC
ocher .... OCH
odor .... ODOR
.... oil
.... OIL
olive .... OLV
oolitic .... OOL
opaque .... OPG
opposite .... OPP
orange .... ORNG
organic .... ORG
orthoclase .... ORTH
ostracod .... OST
oxidized .... OX

P

patchy .... PCHY
part .... PT
parting .... PTG
pearl .... PRL
pebble .... PBL
pegmatite .... PEG
pelecypod .... PLCY
pellet .... PEL
permeability ...... PERM
petroleum .... PET
phosphate .... PHOS
pink .... PNK
pinpoint porosity .... PPP
pisolite .... PISO
pitted .... PIT
plagioclase .... PLAG
plant fossils ..... PL FOS
plastic .... PLAS
platy .... PLTY
polish .... POL
poor .... PR
porcelaneous ..... PORC
porosity .... POR
porphyry .... PORPH
possible .... POS
predominant ...... PRED
preserved .... PRES
primary .... PRIM

prismatic .... PRIS
probably .... PROB
prominent .... PROM
pseudo .... PSDO
purple .... PURP
pyrite .... PYR
pyrobitumen .... PYRBIT
pyroclastic ... PYRCLAS

Q
quartz .... QTZ
quartzite .... QTZT
quartzitic .... QTZTC
quartzose .... QTZS

R
radiate .... RAD
range .... RNG
random .... RAND
rare .... RR
red .... R
regular .... REG
remains .... RMN
replaced .... RPL
residue .... RESD
resinous .... RSNS
rhombohedral ... RHMB-L
rock .... RK
round .... RND
rounded .... RNDD
rubbly .... RBLY
rusty .... RST

S
salt .... SALT
saccharoidal ...... SACC
sample .... SMPL
sand .... SD
sandstone .... SS
sandy .... SDY
saturated .... SAT
scales .... SC
scarce .... SCS
scattered .... SCAT
schist .... SCH
scolecondonts .... SCOL
secondary .... SEC
sediment .... SED
selenite .... SEL
sericite .... SER
severe .... SEV
shale,-ly .... SH,SHY
siderite .... SID
silica .... SIL
silceous .... SILIC
silky .... SLKY
silt .... SLT
siltstone .... SLTST
size .... SZ
slickensided ...... SLKS
slight .... SL
small .... S
smooth .... SMTH
soft .... SFT
soluble .... SOLB
solution .... SOL
sort .... SRT
speck .... SPCK
sphalerite .... SPHAL
spherules .... SPH
spicule .... SPIC
splintery .... SPL
sponge .... SPG
spore .... SPR
spot .... SP
stain .... STN
stained .... STND
staining .... STNG
stippled .... STIP
strata .... STRAT
streak .... STR
striated .... STRI
stringer .... STRG
stromatoparoids . STROM
structure .... STRUC
styolite .... STYL
subangular .... SUBANG
subhedral .... SUBHED
sucrose .... SUC
sulphur .... SULF
surface .... SURF

T
tabular .... TAB
texture .... TEX
thick .... THK
thin .... THN
through .... THRU
tight .... TT
tourmaline .... TOUR

trace . . . . TR
transparent . . . . . . TRNSP
trilobite . . . . TRILO
tripolitic . . . . TRIP
tubular . . . . TUB
tuff . . . . TUFF

U
unconformity . . UNCONF
unconsolidated . UNCONS
upper . . . . UP

V
variable . . . . VAR
varicolored . . . . VCOL
variegated . . . . VGTD
varved . . . . VRVD
vein . . . . VN
vertebrate . . . . VRTB
very V
vesicular . . . . VES
vitreous . . . . VIT
volcanics . . . . VOLC
vug,-gy,-ular . . . . VUG

W
water . . . . WTR
wavy . . . . WVY
waxy . . . . WXY
weather . . . . WTHR
weathered . . . . . WTHRD
white . . . . WH
with . . . . W/

Y
yellow . . . . YEL

Z
zone . . . . ZN

5.10.4. Documentation

A field notebook will be kept for the bedrock ground water sampling. At a minimum, the field notebook will include project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook.

Test boring logs will be completed for the core description. Ground water sampling logs will be completed for the ground water sample. The field notebook will also note the sections of core sent for petrographic analysis. Chain-of-custody procedures will be followed for both the ground water samples and the core sections.

5.11. Shallow residential area ground water sampling

5.11.1. Rationale/design

Ecology and Environment (1998) identified several homes on Walnut Street and Judith Lane with private water wells. Shallow ground water samples will be collected at two sampling stations to evaluate if site-related constituents are migrating from Dead Creek toward these domestic wells (Figure 7). One sampling station will be located at the end of Walnut Street, and the other sampling station will be located on the east bank of Dead Creek at Judith Lane. Ground water samples at each of the two locations will be collected at the water table and at depths of 20 and 40 ft below ground surface which bracket the typical completion depth of domestic wells in southern Illinois. Push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques will be used to collect six ground water samples.

Number of Ground Water Samples	6	
Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 8 is a sample and analysis summary of this activity.

5.11.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.11.3. Field procedure

Using direct push, a MicroWell™ will be installed at the water table at 20 ft below existing grade and 40 ft below existing grade. The MicroWell™ will be installed by driving a steel casing to the desired depth. A 2-inch, slotted, schedule 80 polyvinyl chloride (PVC) screen with a protective cotton sleeve and riser assembly will be threaded to an expendable point inside the steel casing. The steel casing will be removed, leaving the PVC screen and riser in place. The formation material will be allowed to collapse, and the surface will be sealed with bentonite. A PID, an explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

Polyethylene tubing will be placed down the center of the MicroWell™ to approximately two to three feet above bottom. A section of flexible tubing will be attached to the tubing and connected to a peristaltic pump. The free end of the flexible tubing will be positioned to discharge to a 5-gal bucket. The peristaltic pump will be turned on at an approximate flowrate of 100 ml/min, and purging will begin. Purging will continue for 60 minutes. Should the 5-gal bucket become nearly full, it will be replaced, and the full bucket will be emptied into a 55-gal drum. While the well is purging, sample bottle labels will be completed, and sample containers labeled. Turbidity, pH, and conductivity will be calibrated in accordance with the QAPP at the sampling locations and the data will be recorded in the field notebook and the ground water sampling log After 60 minutes, pH, conductivity, temperature, and turbidity will be measured and recorded in the field notebook and on ground water sampling logs. If the turbidity is greater than 5 NTU, purging will continue. Once the turbidity is at or below 5 NTU, samples will be collected. Should a turbidity level of 5 NTU be unachievable after 2 hours of purging, samples will be collected and the turbidity noted. The VOC sampling container will be filled first, followed by the remaining containers. After the sample containers are filled, they will be placed on ice in a cooler, and chain-of-custody procedures will be initiated. After sample collection, the MicroWells™ will be pulled, and the holes filled with bentonite.

5.11.4. Documentation

A field notebook will be kept for the MicroWell™ installation. At a minimum, the field notebook will include project name and number; date and time; weather conditions; sampler's name; sample location; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; other personnel on-site; and pH, conductivity, temperature, PID, explosimeter, RAM, and turbidity measurements. Ground water sampling logs with calibration values will also be completed. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook.

5.12. Time-series sampling

5.12.1. Rationale/design

After collection and analysis of the shallow ground water vertical-profile samples at Walnut Street and Judith Lane, one MicroWell™ will be installed at each sampling station with its screened interval in the zone of highest detected constituent concentrations. USACE required stressing the aquifer at this sampling location. Time-series samples, as required by USACE, will be collected over a 24-hour period with samples collected at 0, 12, and 24 hours after the start of pumping in order to stress the saturated zone during sampling and evaluate constituent concentration trends. Pumping rates can not be determined in advance, but will be set so that the MicroWell™ can be pumped continuously for 24 hours without drying up.

Number of Ground Water Samples 6

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 9 is a sample and analysis summary of this activity.

5.12.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.12.3. Field procedures

MicroWells™ will be installed as described in section 5.9.3. Ground water samples will be collected using polyethylene tubing, flexible tubing, and a peristaltic pump, as described in section 5.9.3. The samples will be collected at the highest flow rate possible (approximately 3400 ml/min) with the peristaltic pump. Ground water samples will be collected when the pump is turned on (0 hr), 12 hours and 24 hours after initializing pumping. Conductivity, temperature, pH, and turbidity will be measured and recorded on the ground water sampling logs and in the field notebook. VOC containers will be filled first, then the remaining containers. Collected samples will be placed on ice in coolers, and chain-of-custody procedure will be initiated. After the 24-hr sample is collected, the MicroWell™ will be pulled, and the hole filled with bentonite.

5.12.4. Documentation

A field notebook will be kept for the MicroWell™ installation. At a minimum, the field notebook will include project name and number; date and time; weather conditions; sampler's name; sample location; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; other personnel on-site; and pH, conductivity, temperature, PID, explosimeter, RAM, and turbidity measurements. Ground water sampling logs with calibration values will also be completed. Notation of USEPA Region V acceptance or boring locations will be included in the field notebook.

5.13. Domestic well sampling

5.13.1. Rationale/design

Ground water samples will be collected from a total of four domestic wells on Walnut Street and Judith Lane that could be used for irrigation or drinking water supply. Preference will be given to sampling wells that were sampled in the past by the IEPA in order to provide some degree of historical record. Past domestic well sampling results, extracted from the 1998 Ecology and Environment report "Volume 1, Sauget Area 1, Data Tables/Map," and included in Appendix C of the SSP, as directed by the USACE.

Number of Ground Water Samples 4

Analyses	VOCs	USEPA Method 8260
	SVOCs	USEPA Method 8270
	Metals	USEPA Method 6010
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 10 is a sample and analysis summary of this activity.

5.13.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.13.3. Field procedures

After the well owners have been contacted and permission obtained in writing to collect well water samples, the well owners will be contacted by O'Brien & Gere to set a time for well sampling. The domestic well samples will be collected from a tap as close as possible to the well head. Available information on well construction and pumps will be reviewed to evaluate the time the water should be allowed to run prior to sample collection for system purging. While the lines are purging, sample container labels can be completed and affixed to the sample containers. After 10 minutes, pH, conductivity, temperature, and turbidity measurements will be obtained. Then the VOC container will be filled, followed by the remaining containers. The sample containers will be placed on ice in a cooler, and chain-of-custody procedures initiated.

5.13.4. Documentation

A field notebook will be kept for the domestic well sampling. At a minimum, the field notebook will include project name and number, date and time, weather conditions, sampler's name, residence address, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Conductivity, pH, temperature, and turbidity measurements will also be recorded in the field notebook. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.14. Slug tests

5.14.1. Rationale/design

A considerable amount of information on the hydraulic characteristics of the American Bottoms aquifer is available from the Illinois Water Survey, Illinois Geological Survey and US Geological Survey. Public information, augmented by site-specific slug tests, may be all that is needed to design a pump and treat system should such a remedial measure be selected for a site. Performance of a pumping test on a high yield aquifer creates practical problems such as storage, treatment, and disposal of large volumes of pumped water. When it is necessary to design a pump and treat system, it may be simpler to use the best available information to design the recovery and treatment system and then add more recovery wells and treatment capacity if the system does not perform as expected. For these reasons, slug testing was selected as the preferred method for evaluating site-specific aquifer hydraulic characteristics.

To conduct the slug tests, three 2-inch diameter, stainless steel piezometers will be installed at each fill area (Sites G, H, I, L, and N) using the installation methods described in section 5.3.3. The slug tests at each fill area will be used to evaluate aquifer hydraulic conductivity. Slug tests will be conducted in the upper fine-grained zone, the middle fine sand zone, and the lower coarse sand zone typical of the American Bottoms aquifer in this area. These depths are estimated to be at 20, 40, and 60 ft, respectively, below ground surface. These depths will be confirmed in the field from the waste characterization boring activities.

Number of Slug Tests 15

5.14.2. QA/QC procedures

QA/QC procedures will consist of equipment test checks at each fill area and two repeat tests.

5.14.3. Field procedures

This section presents the field protocols for the completion of *in situ* hydraulic conductivity tests.

Equipment requirements.

- A pressure transducer connected to a data logger system
- An inert solid slug of sufficient diameter and length to artificially raise or lower the water level 1 ft or more in the well (commonly either a PVC or Teflon® slug)
- A timing device.

Test design.

A. Identify the test objectives and document them.

B. Identify potential limitations of test and interpretation methods as they relate to the project and site.

C. Identify the available database for correlation purposes (other hydraulic conductivity test data, maps, or logs of subsurface soils).

D. Evaluate access to wells and obstructions or siltation in wells.

E. Review boring and well completion logs for wells to be tested for lithology, natural discontinuities, possible well yield, screen length, location of ground water table with respect to the screen interval, and type of sand/gravel pack.

F. Identify the type of *in situ* hydraulic conductivity test to be used.

   1. Only use a rising head test if the screened interval of the well straddles the water table. The introduction of water into the unsaturated portion of the formation during a falling head test will result in an inaccurate estimation of hydraulic conductivity.

   2. If the screened interval of the well is fully submerged below the water, use both the rising or falling head test and average the results.

G. Evaluate the amount of head change to be induced in the well.

H. Evaluate the water level measurement frequency needed.

1. During the early portions of the test, measure water levels at closely spaced intervals. The frequency of measurements will be governed by the rate of recovery of the water level in the well. The faster the recovery, the more frequently the measurements need to be taken. Measurement frequency can decline logarithmically during the test (the length of time between measurements increasing during the test). Water levels should be recorded until the water level has recovered to 95% of static pre-test conditions.

I. Identify the type of slug and water level recording device to be used.

1. Choose the manual or electronic method based upon previously calculated hydraulic conductivity (K) values or expected K based upon grain size encountered within the well:

   a. If $K > 10^{-3}$ cm/sec, use pressure transducer
   b. If $K < 10^{-3}$ cm/sec, use pressure transducer or manual method.

Field protocols.

A. Record the following information in the project notebook and the slug test field log in Appendix F:
   Name
   Date
   Project name and description
   Project number
   Weather conditions
   Well number and well location in sufficient detail to relocate.

B. Measure and document static head. If a pressure transducer is to be used, lower transducer into well, and secure the pressure transducer cable to the well to prevent movement. Connect the pressure transducer to the electronic data logger. Measure the static head with both the transducer and manually, then start the automatic recording by the data logger.

C. Insert the slug into or withdraw the slug from the ground water in the well.

1. Given the variability of test conditions, there is no absolute requirement for the magnitude of the change in water level. It is suggested that a minimum of 1 ft instantaneous hydraulic head change be created to allow for effective measurement of aquifer response. About 75% of the

estimated displacement by the slug should be documented in the water level recordings.

D. Measure the recovery of the water level in the well until 95% recovery to static conditions has been achieved.

1. For manual measurements, record the time (real or elapse time) and the depth to ground water in the well in the project field book. All measurements should be from the same point on the well casing using the same well probe.

2. For the pressure transducer, the time and water level will be automatically recorded.

E. Data Review

1. Make sure the necessary information is documented for each test within the field notebook and on a slug test field log.

2. Make a preliminary analysis of data before leaving the field to evaluate if test was successful:

   a. Did the slug create an instantaneous head change in the well of sufficient magnitude to observe a meaningful water level response?

   b. Did you collect a sufficient number of data points to define the water level recovery for the test?

   c. Is the test data generally consistent with your pre-test expectations?

   d. If the test was not successful, reevaluate the test design and complete a new test.

3. For electronic tests, copy the data file onto a disk and label the disk with the project number, date, test well, and file name.

5.14.4. Documentation

A field notebook will be kept for the slug test evaluation. At a minimum, the field notebook will include project name and number, date and time, weather conditions, tester's name, slug test location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook. Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors. If necessary, a slug test will be re-conducted.

5.15. Grain size analysis

5.15.1. Rationale/design

One soil boring will be completed adjacent to each fill area (Sites G, H, I, L, and N) to identify grain size of aquifer materials. Soil samples will be collected from the upper, middle, and lower aquifer zones (total of fifteen samples) using a Geoprobe™ or other suitable push technology. Sample locations will be selected in the field with the concurrence of the USEPA Region V or its designee. Each soil sample will be analyzed for grain size.

Number of Grain Size Analyses 15

Table 11 is a sample and analysis summary of this activity.

5.15.2. QA/QC samples

As this is a physical test, no QA/QC samples will be submitted.

5.15.3. Field procedure

A large bore (MacroCore®) soil sampler, using clear acetate liners, will be hydraulically pushed to collect a soil sample at specified depths. The collected sample will be placed into labeled plastic, wide-mouth containers and sealed. The MacroCore® sampler will collect approximately 1300 mL of material, which is sufficient for grain size analysis. Should larger (large gravel to cobble) size materials be encountered, additional core samples will be obtained and placed into additional containers. Collected samples will be placed into plastic coolers or corrugated boxes for shipment. Chain-of-custody procedures will be followed in order to track samples. The samples will be submitted for grain size analysis using a sieve and hydrometer testing. Geoprobe™ holes will be filled with bentonite.

5.15.4. Documentation

A field notebook will be kept for the soil probing installation. At a minimum, the field notebook will include project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook.

5.16. Upgradient ground water sampling

5.16.1. Rationale/design

Existing wells EE-20, EE-04, and EEG-108 will be used as background (upgradient) ground water sampling locations. These wells, which are screened at depths of 23-28, 18-23, and 24-29 ft below ground surface, respectively, will be redeveloped as described in section 5.7. If these wells cannot be used, Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology will be used to collect samples from the center of the former screened intervals at each of these locations using low-flow sampling techniques. In addition, ground water samples will be collected at depths of 60 and 100 ft below grade surface at each of these locations using push sampling technologies such as Geoprobe™, HydroPunch™, MicroWell™, Waterloo Profiler™, or equivalent sampling technology and low-flow sampling techniques. A sampling depth of 60 ft is approximately the midway between the screened interval of the existing shallow wells and the bottom of the aquifer, which is anticipated to be approximately 100 ft deep.

Number of Ground Water Samples 9

Analyses	VOCs	USEPA Method 8260
	SVOCs	USEPA Method 8270
	Metals	USEPA Method 6010
	Mercury	USEPA Method 7470A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 12 is a sample and analysis summary of this activity.

5.16.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.16.3. Field procedures

Field procedures for collection of upgradient ground water samples will follow the procedures for well redevelopment and collection of ground water in the fills areas, described in section 5.7.3.

5.16.4. Documentation

A field notebook will be kept for the upgradient ground water sampling. At a minimum, the field notebook will include project name and number, date and time, weather conditions, sampler's name, residence address, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Conductivity, pH, temperature, and turbidity measurements will also be recorded in the field notebook. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.17. Soil sampling

Soil samples will be collected in both undeveloped and developed areas that are susceptible to flooding and deposition of wind-blown dust. Specifically, floodplain soil sampling will be conducted in an area bounded by Queeny Road on the north, Falling Springs Road on the east, Illinois Route 157 on the south, and Illinois Route 3 (Mississippi Avenue) on the west. This is the area where water backs up at road crossings during heavy rains and where PCBs are known to occur in creek sediments. This area also includes most of the residential development in Sauget Area 1.

Information from the soil sampling program will be used to evaluate the extent of migration due to overbank flooding and wind-blown dust deposition. In addition, surficial and subsurface soil information will be used in the human health risk assessment (construction/utility worker and residential exposure scenarios). The Human Health Risk Assessment Work Plan is in Volume 1B of the SSP.

Floodplain soil samples will be collected every 200 ft on seven transects in undeveloped areas, a total of forty-five sampling stations. Based on these sampling results, twenty soil sampling stations will be located in developed areas. Three samples will be collected in developed areas adjacent to Transects 1, 2, 3, 4, 5, and 6, and two samples will be collected in developed areas adjacent to Transect 7, which is the transect at the downgradient limit of the residential area. Twenty developed area samples are considered an appropriate number for identification in the SSP until undeveloped area soil samples and Creek Segment B, C, D, and E sediment samples are collected and analyzed. Then, this information on the extent and concentration of constituents in undeveloped area floodplain soils and creek sediments can be used to select developed area sampling locations.

5.17.1. Undeveloped area surface soil sampling

Rationale/design. Surficial (0 to 0.5 ft) soil samples will be collected every 200 ft on seven transects perpendicular to Dead Creek to evaluate the extent of migration via the surface water (overbank flow) and air (wind-blown dust) pathways (Figure 8). Sampling transects are placed in undeveloped areas adjacent to developed areas to allow ready access for sampling. VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Transect	Length	Number of Sampling Stations	Number of Surficial Soil Samples	Number of Subsurface Soil Samples
1	1,300'	7	7	7
2	1,000'	6	6	6
3	1,300'	7	7	7
4	1,300'	7	7	7
5	1,000'	6	6	6
6	800'	5	5	5
7	1,200'	7	7	7
Total		45	45	45

Number of Undeveloped Area Surficial Soil Samples 45

Analyses		
	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 13 is a sample and analysis summary of this activity.

5.17.2. Undeveloped area subsurface soil sampling

Rationale/design. Subsurface (0.5 to 6 ft) soil samples will be collected every 200 ft on seven transects perpendicular to Dead Creek to evaluate the extent of migration via the surface water (overbank flow) and air (wind-blown dust) pathways (Figure 8). Subsurface soil samples will be collected from 0.5 ft to 6 ft below ground surface. Visual observation (discoloration) and field PID readings will be used to identify the most impacted portion of the sample. This section will be selected for chemical analysis. Surface and subsurface soil sampling stations will be co-located. VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Number of Undeveloped Area Subsurface Soil Samples 45

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 14 is a sample and analysis summary of this activity.

5.17.3. Undeveloped area soil dioxin sampling

Rationale/design. As directed by USACE, 20% of the surface soil samples will be analyzed for dioxin. To provide information for the human health risk assessment (construction/utility worker exposure), USEPA Region V directed that 20% of the subsurface soil samples will be analyzed for dioxin. Visual observation (discoloration) and field PID readings will be used to identify the most impacted portion of the sample. This section will be selected for chemical analysis.

Number of Undeveloped Area Surface Soil Dixoin Samples	9
Number of Undeveloped Area Subsurface Soil Dioxin Samples	9

Analyses	Dioxin	USEPA Method 8280

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Tables 13 and 14 are sample and analysis summaries of this activity.

5.17.4. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.17.5. Field procedures

Surficial sampling. At the outset of surface soil sampling, follow these instructions. Surface soil samples will be discrete:

Discrete sample represents a single location in the soil column. This type of sample is also used for discrete analysis of surface soil conditions. Discrete soil samples are collected from near surface soils at locations identified in a work plan. Hand augers, disposable scoops, hand trowels, or shovels are used to collect these samples.

Use the following procedure to collect a sample:

1. If necessary, penetrate the soil to the appropriate sampling depth.

2. Using a clean tool, remove and discard a thin layer of soil from the area. Record the characteristics of the soils including grain size, content, staining, and color.

3. To collect a discrete soil sample for VOC analysis, a 5-gram EnCore® sampler will be used. After pressing the sampler into the soil at the sampling location, cap the coring body while it is still in the EnCore® sampler T-handle. To collect a discrete soil sample for other parameters, use a stainless steel laboratory spoon or equivalent. Homogenize the non-VOC samples as necessary.

4. Place the homogenized sample into appropriate sample containers. In addition to analytical samples, a referencé sample considered representative of the soil may also be collected in a wide mouth jar and stored for possible future physical analyses such as grain size analysis.

5. Check that the cap of each sample container has a Teflon® liner, if required for the analytical method. Secure the cap tightly.

6. Label the sample container with the appropriate sample tag. The tags could be permanent labels or clean tape. Label the tag carefully and clearly using indelible ink. Complete appropriate sampling forms and record in the field notebook. Pre-labeled containers are handy, particularly if you are wearing gloves or if the weather is inclement.

7. Initiate the chain-of-custody form.

8. Place the capped EnCore® sampler core bodies and other sample containers on ice in a cooler to maintain the samples at approximately 4 °C. Ship the cooler to the laboratory for analysis within 48 hr of sample collection.

9. Decontaminate equipment between sample locations and after use as described in section 5.7.3.

Subsurface sampling. A steel hand auger will be used to collect soil samples at a depth of 0.5 to 6 ft below existing grade. Soil samples will be collected by placing a 4 ft by 4 ft piece of plastic sheeting on the ground over the location where the surface soil sample was collected. A hole will be cut in the plastic sheeting for insertion of the hand auger. The hand auger will then be used to make a borehole in the soil. Soil between the surface and 3 ft below existing grade will be placed on the plastic sheeting. Upon reaching a depth of 3 ft below existing grade, collected soil samples will be placed into labeled, laboratory-supplied, clean sample containers. A 5-gram EnCore® sampler will be used to collect VOC samples from the subsurface. After collection of soil in the hand auger and before homogenization, the EnCore® sampler will be used to collect a VOC sample from the hand auger. Filled, labeled and capped EnCore® sampler core bodies and sample containers will be placed on ice in a cooler. Chain-of-custody procedures will be followed. The borehole will be filled with bentonite. The surface (top 2 ft) will be restored with soil and seeded. Boring-generated soils will be contained and transported to the centrally located solid waste disposal container. General waste will be contained in plastic bags and disposed of in a general refuse container.

Should hand augering prove impractical, a direct push technology will be used to collect the soil sample. The soil sample will be collected using the MacroCore® sampler. The MacroCore® sampler will have a clear acetate liner. The push sample will be collected from 3 to 6 ft below grade. A VOC sample will be collected from the top portion of the sample using a 5-gram EnCore® sampler. The remaining portion will be homogenized in a stainless steel bowl and used to fill the remaining sample containers. The collected samples will be placed on ice in a cooler, and chain-of-custody procedures will be followed. The boreholes will be filled with bentonite. A PID, an explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

5.17.6. Documentation

A field notebook will be kept for the soil boring installation. At a minimum, the field notebook will include the project name and number; date and time; weather conditions; sampler's name; sample location; depth of boring; PID, explosimeter, and RAM readings; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; and other personnel on-site. Notation of USEPA Region V acceptance of boring locations will be included in the field notebook.

5.18. Soil sampling, developed areas

5.18.1. Developed area surface soil sampling

Rationale/design. Surficial soil samples (0 to 0.5 ft below ground surface) will be collected in at least twenty locations in developed areas. Soil samples will be collected at three residences adjacent to Transects 1 to 6 and at two residences adjacent to Transect 7.

Number of Developed Area Surface Soil Samples 20

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 15 is a sample and analysis summary of this activity.

5.18.2. Developed area subsurface soil sampling

Rationale/design. Subsurface soil samples (0.5 to 6 ft below ground surface) will be collected in at least twenty locations in developed areas. Soil samples will be collected at three residences adjacent to Transects 1 to 6 and at two residences adjacent to Transect 7. Visual observation (discoloration) and field PID readings will be used to identify the most impacted portion of the sample. This section will be selected for chemical analysis. VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Number of Developed Area Subsurface Soil Samples 20

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 16 is a sample and analysis summary of this activity.

5.18.3. Developed area soil dioxin sampling

Rationale/design. Ad directed by USACE, 20% of the surface soil samples will be analyzed for dioxin. To provide information for the human health risk assessment (construction/utility worker exposure), USEPA Region V directed that 20% of the subsurface soil samples will be analyzed for dioxin. Visual observation (discoloration) and field PID readings will be used to identify the most impacted portion of the sample. This section will be selected for chemical analysis.

Number of Developed Area Surface Soil Dixoin Samples	4
Number of Developed Area Subsurface Soil Dioxin Samples	4

Analyses	Dioxin	USEPA Method 8280

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Tables 15 and 16 are sample and analysis summaries of this activity.

5.18.4. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.18.5. Field procedures

Field procedures for collection of surface and subsurface soil samples in developed areas will follow the procedures for collection of surface and subsurface soil samples in undeveloped areas as described in section 5.17.5.

5.18.6. Documentation

A field notebook will be kept for surface and subsurface soil sampling. At a minimum, the field notebook will include the project name and number; date and time; weather conditions; sampler's name; sample location; depth of boring; PID, explosimeter, and RAM readings; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; and other personnel on-site. Notation of USEPA Region V acceptance of surface and subsurface soil sampling locations will be included in the field notebook.

5.19. Background soil samples

5.19.1. Rationale/design

Background soil samples will be collected at the locations of the background ground water wells, specifically existing wells EE-20, EE-04 and EEG-108 which are east of Sites I, H, and L, respectively. Samples will be collected from depths of 0 to 0.5 ft and 0.5 to 6 ft below ground surface. Visual observation (discoloration) and PID readings will be used to identify the most impacted portion of the sample for analysis. VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Number of Background Soil Samples 6

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8280

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 17 is a sample and analysis summary of this activity.

5.19.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.19.3. Field procedures

Field procedures for collection of background soil samples will follow the procedures for collection of soil samples in the undeveloped areas, described in section 5.17.5.

5.19.4. Documentation

A field notebook will be kept for background soil sampling. At a minimum, the field notebook will include the project name and number; date and time; weather conditions; sampler's name; sample location; depth of boring; PID, explosimeter, and RAM readings; limiting field conditions; problems encountered; subcontractor personnel on-site; USEPA Region V personnel on-site; and other personnel on-site. Notation of USEPA Region V acceptance of background soil sampling locations will be included in the field notebook.

5.20. Sediment sampling

Vertically integrated sediment samples will be collected in Dead Creek to evaluate the extent of downstream migration of site-related constituents and to provide information for use in the human health risk assessment (recreational teenage and recreational fishing scenarios) and the ecological risk assessment (endpoint organism exposure to sediments). The Human Health Risk Assessment Work Plan is in Volume 1B of the SSP, and the Ecological Risk Assessment Work Plan is in Volume 1C. It should be noted that sediment samples will be collected beginning at the most downgradient location and after collection of surface water samples. Given the 17,000-ft length of Dead Creek, sediment sampling at 400-ft intervals will provide sufficient information to evaluate the extent of downstream migration of industry-specific constituents. As directed by USEPA Region V, sediment samples will be collected at 200-ft intervals in the undeveloped portions of Dead Creek (*i.e.*, Creek Segments B and F) and at 150-ft intervals in the developed portions of Dead Creek, specifically Creek Segments C, D, and E, to evaluate the extent of migration of industry-specific constituents. A 150-ft sediment sampling interval was used in the 1991 Geraghty & Miller investigation of Creek Segment B; therefore, repeating sample collection at a

150-ft interval is not considered appropriate in this creek segment even though its southern end passes through a developed area. For this reason, sediment samples will be collected at 200-ft intervals in Creek Segment B. Sediment samples will be collected every 1000 ft in Dead Creek to evaluate the extent of migration of site-related constituents.

As directed by USACE, sediment sampling locations in Creek Segments B, C, D, E, and the portion of Creek Segment F upstream of Borrow Pit Lake will be adjusted in the field so that samples are obtained at the upstream and downstream ends of each road culvert at a specified radial distance from the culvert. Samples will be collected within a radial distance of 10 ft from the upstream and downstream end of each road culvert.

The extent of migration information collected as part of this task, coupled with sediment thickness measurements and channel cross-sectional area, will provide enough information to evaluate the volume of impacted sediments.

Sediment samples will not be collected in Creek Segment A. This creek segment was used as a storm water detention basin which was dredged a number of times to remove accumulated sediment. Dredge spoil was placed on the creek banks and Site I. Cerro Copper performed an IEPA-approved remedial action for Creek Segment A in 1990 and 1991. Approximately 20,000 yd^3 of impacted sediments were excavated from depths of 10 to 15 ft below grade and transported off site for disposal at the Waste Management landfill in Emelle, Alabama. After excavation, an HDPE vapor barrier was installed, and Creek Segment A was backfilled. The site is now fenced and used as a controlled-access truck parking lot. Since Creek Segment A was remediated under an agreement with IEPA, no further characterization is considered necessary.

5.20.1. Undeveloped area sediment sampling

Rationale/design. Vertically integrated sediment core samples will be collected at 200-ft intervals in Creek Segment B and Creek Segment F to evaluate the extent of downstream migration of constituents related to specific industrial sources located at the upstream end of Dead Creek (Figure 9). The combined length of these creek segments is approximately 10,000 ft. Industry-specific constituents include PCBs (discontinued chemical manufacturing operation), total petroleum hydrocarbons (TPH) (closed oil refinery), copper (active metal refining), and zinc (active metal refining). This information will also be used in the human health risk assessment.

Samples will be collected in depositional areas at the thickest sediment profile. Channel cross-section will be surveyed at each sampling station, and sediment depth will be measured at three locations perpendicular to the channel (channel center, half way between channel center and right channel edge, and half way between channel center and left channel edge).

Number of Sediment Samples 50

Analyses	PCBs	USEPA Method 680
	TPH	USEPA Method 8015B
	Copper	USEPA Method 7211
	Zinc	USEPA Method 7951
	TOC	USEPA Method 9060
	Grain Size	Physical Method
	Solids Content	USEPA Method SM2540G

Savannah Laboratories, which will perform the sediment analyses, does not have a procedure in their QAPP for analyzing zinc by AA. Savannah Laboratories has all the necessary equipment to conduct this analysis, but does not have the necessary lamp. This lamp will be purchased prior to the start of sample collection.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 18 is a sample and analysis summary of this activity.

QA/QC samples. QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MS/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten or fraction of ten environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples.

Field procedures. Creek channel cross-sections will be completed prior to collecting sediment samples for volumetric calculation. Sediment samples will be collected at the thickest part of the sediment profile as identified by the surveyors. Sediment samples will be collected using a manual push-type sediment core sampler. The sampler consists of a PVC barrel, polycarbonate (Lexan®) liner, check valve, extension rods, and a "T" handle. A liner will be placed into the bottom of the tube and secured in place. The sampler will then be pushed into the sediment, collecting a sediment sample from 0 to 12 inches below the sediment layer. The sediment will be pulled up, creating a slight vacuum that closes the check valve. The tube will be removed from the sample, and the sediment will be placed into the sample containers. Where water depths require, extensions will be added to the sample tube to facilitate collecting the sediment sample. In these instances, a boat will be used to reach the sampling location. In Dead Creek, a ladder will be used as necessary to facilitate sample collection. Sample containers will be placed on ice in coolers. Chain-of-custody procedures will be followed. After each sampling location or when all decontaminated sampling equipment has been used, decontaminate the sampling equipment according to the procedures outlined in section 5.7.3.

Documentation. A field notebook will be kept for the sediment sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.20.2. Developed area sediment sampling

Rationale/design. Vertically integrated sediment core samples will be collected at 150-ft intervals in Creek Segments C, D, and E to evaluate the extent of downstream migration of constituents related to specific industrial sources located at the upstream end of Dead Creek (Figure 9). The combined length of these creek segments is approximately 7000 ft. Industry-specific constituents include PCBs (discontinued chemical manufacturing operation), TPH (closed oil refinery), copper (active metal refining), and zinc (active metal refining). This information will also be used in the human health risk assessment.

Samples will be collected in depositional areas at the thickest sediment profile. Channel cross-section will be surveyed at each sampling station, and sediment depth will be measured at three locations perpendicular to the channel (channel center, half way between channel center and right channel edge, and half way between channel center and left channel edge).

- Number of Sediment Samples 47

Analyses	PCBs	USEPA Method 680
	TPH	USEPA Method 8015B
	Copper	USEPA Method 7211
	Zinc	USEPA Method 7951
	TOC	USEPA Method 9060
	Grain Size	Physical Method
	Solids Content	USEPA Method SM2540G

Savannah Laboratories, which will perform the sediment analyses, does not have a procedure in their QAPP for analyzing zinc by AA. Savannah Laboratories has all the necessary equipment to conduct this analysis, but does not have the necessary lamp. This lamp will be purchased prior to the start of sample collection.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 19 is a sample and analysis summary for this activity.

QA/QC samples. QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MS/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples.

Field procedures. Field procedures for the collection of sediment samples for developed areas will follow the procedures for sediment sample collection as outlined in section 5.20.1.

Documentation. A field notebook will be kept for the sediment sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.20.3. Borrow pit lake sediment sampling

Rationale/design. A 200-ft sediment sampling interval was used for Dead Creek to define downstream concentration distributions and gradients. Since half of the 6000-ft long Borrow Pit Lake lies north of the point where Dead Creek discharges into it, two sediment sampling stations were considered adequate for the upstream portion of Borrow Pit Lake. Sampling at 200-ft intervals in the portion of Borrow Pit Lake north of the discharge of Dead Creek as requested by the USEPA Region V would result in a total of fifteen samples, which is more data than is needed to define the distribution of industrial source-specific constituents resulting from the discharge of Dead Creek into Borrow Pit Lake. A 400-ft sampling interval, a total of eight samples, in the northern half of Borrow Pit Lake will provide enough information to define the distribution of sediments resulting from the discharge of Dead Creek into Borrow Pit Lake.

Therefore, vertically integrated sediment core samples will be collected at 400-ft intervals from upstream end of Borrow Pit Lake in Creek Segment F down to the confluence of Dead Creek with the lake in order to evaluate the distribution of constituents related to specific industrial sources located at the upstream end of Dead Creek (Figure 9). Industry-specific constituents include PCBs (discontinued chemical manufacturing operation), TPH (closed oil refinery), copper (active metal refining), and zinc (active metal refining). This information will also be used in the human health risk assessment.

Samples will be collected along the center line of the lake. While sediment deposition is likely at the point where Dead Creek enters Borrow Pit Lake, sediment transport north of the confluence will be limited by backwater depositional processes and streamflow into the north end of the lake.

Number of Sediment Samples 8

Analyses	PCBs	USEPA Method 680
	TPH	USEPA Method 8015B
	Copper	USEPA Method 7211
	Zinc	USEPA Method 7951
	TOC	USEPA Method 9060
	Grain Size	Physical Method
	Solids Content	USEPA Method SM2540G

Savannah Laboratories, which will perform the sediment analyses, does not have a procedure in their QAPP for analyzing zinc by AA. Savannah Laboratories has all the necessary equipment to conduct this analysis, but does not have the necessary lamp. This lamp will be purchased prior to the start of sample collection.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 20 is a sample and analysis summary for this activity.

QA/QC samples. QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MS/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples.

Field procedures. Field procedures for the collection of sediment samples for Borrow Pit Lake will follow the procedures for sediment sample collection as outlined in section 5.20.1.

Documentation. A field notebook will be kept for the sediment sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.20.4. Dead Creek sediment sampling

Rationale/design. Vertically integrated sediment core samples will be collected every 1000 ft in Dead Creek, from the upstream end of Creek Segment B to the downstream end of Creek Segment F at the Old Prairie du Pont Creek lift station, to evaluate the extent of downstream migration of target compound list/target analyte list (TCL/TAL) constituents (Figure 10). These broad-scan analyses are also intended to provide information for the human health risk assessment.

Two sediment core samples will be collected in Borrow Pit Lake in Creek Segment F upstream of the discharge of Dead Creek to assess the effect of backwater conditions and/or the contributions of other sources. One sample will be collected upstream, and one sample will be collected downstream of the confluence of Dead Creek and Old Prairie du Pont Creek to evaluate the impact of the Dead Creek discharge on sediment quality in Old Prairie du Pont Creek.

The location of the upstream sample in Old Prairie du Pont Creek will be collected at an appropriate distance from the confluence with Dead Creek so that possible previous effects of flooding and flow reversals will not affect the collection of the background sample. As reported in the 1996 HRS package prepared by PRC Environmental Management, Inc. for USEPA Region V, a background sampling station was located 200 ft north of the confluence of Dead Creek and Old Prairie du Pont Creek. The sediment background sample will be collected at this location.

Samples will be collected in depositional areas at the thickest sediment profile. Channel cross-section will be surveyed at each sampling station and sediment depth will be measured at three locations perpendicular to the channel (channel center, half way between channel center and right channel edge, and half way between channel center and left channel edge).

Number of Sediment Samples 20

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290
	TOC	USEPA Method 9060
	Grain Size	Physical Method
	Solids Content	USEPA Method SM2540G

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 21 is a sample and analysis summary for this activity.

QA/QC samples. QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MS/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

Field procedures. Dead Creek sediment samples will be collected using the same equipment and methods as described in section 5.20.1. However, VOC samples will be collected using EnCore® samplers per USEPA Method 5035.

Documentation. A field notebook will be kept for the sediment sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.20.5. Ecological sediment sampling

Rationale/design. In support of the Ecological Assessment Sampling Plan, sediment samples will be collected at the number of sampling stations indicated at each of the following locations:

- Creek Segment B - 3 sampling stations
- Creek Segment C - 3 sampling stations
- Creek Segment D - 3 sampling stations
- Creek Segment E - 3 sampling stations
- Creek Segment F, between Route 157 and Borrow Pit Lake - 3 sampling stations
- Creek Segment F, in Borrow Pit Lake - 3 sampling stations
- Reference Area 1 - 2 sampling stations
- Reference Area 2 - 2 sampling stations
- Site M - 1 sampling station.

Each sediment sampling station will coincide with the location where Menzie-Cura will be collecting ecologicial samples for evaluation and will be collected during the ecological sample collection activities. The three sampling stations within Creek Segment B, C, D, E, F, and Borrow Pit Lake will be selected so that they approximately coincide with the maximum, average, and minimum concentrations of site-related constituents detected in each creek segments during the sediment sampling and analysis program designed to delineate the extent of migration of the industry-specific constituents, as discussed in sections 5.20.1, 5.20.2, and 5.20.3. The two sampling stations in each Reference Area 1 and Reference Area 2 will be either in the Dead Creek watershed or in a watershed that includes industrial, commercial, residential, and farming land uses. The areas will be comparable to those found in the Dead Creek watershed in order to provide a basis for comparison with Dead Creek. The exact locations will be determined after the Ecologicial Assessment Site Reconnaissance Survey is performed. Additionally, one sampling station will be selected at Site M.

The sediment samples collected for the Ecological Assessment will assist in the evaluation of the extent of downstream migration of target compound list/target analyte list (TCL/TAL) constituents (Figure 11). These broad-scan analyses are also intended to provide information for the ecological risk assessments.

Samples will be collected from the biological active zone of the sediment. This zone is approximately within the top six inches of the sediment. VOC samples will be collected using a 5-gram EnCore® sampler per USEPA Method 5035.

Number of Ecologicial Sediment Samples 23

Analyses	VOCs	USEPA Method 5035/8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010B
	Mercury	USEPA Method 7471A
	Cyanide	USEPA Method 9010B
	PCBs	USEPA Method 680
	Pesticides	USEPA Method 8081A
	Herbicides	USEPA Method 8151A
	Dioxin	USEPA Method 8290

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 22 is a sample and analysis summary for this activity.

QA/QC samples. QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MS/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

Field procedures. Sediment samples for the ecological assessment will be collected using a tall Ekman grab sampler. The Petite Ponar grab sampler with sliding screens will be used as a back-up sampling devise. The Ekman grab sampler will either be deployed over the side of a boat or by wading depending upon the depth of the surface water body. Sampling will begin at the furthest downstream sediment sampling station and proceed upstream. It is the intent of the ecological sediment sampling to collect sediment samples from 0 to 6 inches below the sediment layer. Due to the volume of sediment required to perform the chemical analysis and the toxicity testing for the ecological assessment, it has been estimated that six to eight grab samples will need to be collected at each sampling location. The following procedures will be followed for the collection of the ecological sediment samples:

- Identify the sampling location and document it in the field logbook.
- Position the boat stern at the sampling point and drop anchor from the bow. Should wading be employed for sample collection, sampler should be positioned upstream of the sample point.
- Pre-label sample containers.
- Don protective clothing.
- Deploy grab sampler with open jaws slowly, hand over hand, over the side of the boat.
- When sampler feels the grab sampler has penetrated the bottom sediment, send the messenger down the grab sampler line to activate the closure mechanism of the jaw or trigger with a pole in shallow waters.
- Slowly retrieve the grab sampler by slowly pulling to the surface.
- When the grab sampler is visible and along side of the boat, a field assistant will be ready with a bin to place the grab sampler in.
- Carefully decant excess water from the grab sampler and remove the mesh screen for access to the sediments.
- Measure the depth of the sediments in the grab sampler using a decontaminated ruler. There should be at least 6 inches (15 centimeters) of sediments in the grab sampler for collection of samples for evaluation.

- If enough sediment depth was obtained, first collect a sediment sample for VOC analysis from the grab sampler using an EnCore® sampler. Follow the general EnCore® sample collection procedures as discussed in section 5.17.5.

- The remaining samples for chemical analysis and toxicity testing will be obtained from subsequent homogenized grab samples collected at the same sampling point. Decontaminated stainless steel spoons and bowls will be used for homogenization. As stated previously, it is anticipated that six to eight grab samples will be necessary at each location to obtain the necessary amount of sediment sample volume.

- Place the homogenized samples into appropriate containers and complete the sample labels.

- Place the samples in a cooler on ice.

- Initiate chain-of-custody procedures for samples collected.

- After each sampling location or when all decontaminated sampling equipment has been used, decontaminate the sampling equipment according to the procedures outlined in section 5.7.3.

Documentation. A field notebook will be kept for the sediment sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.21. Surface water sampling

5.21.1. Rationale/design

Surface water samples will be collected to evaluate the extent of downstream migration of site-related constituents and to provide information for use in the human health risk assessment (trespasser and recreational fishing scenarios) and the ecological risk assessment (endpoint organism exposure to surface water). The Human Health Risk Assessment Work Plan is in Volume 1B of the SSP and the Ecological Risk Assessment Work Plan is in Volume 1B.

Surface water samples will be collected every 1000 ft in Dead Creek, from the upstream end of Segment B to the downstream end of Segment F at the Old Prairie du Pont Creek lift station, to evaluate the extent of downstream migration of site-related constituents (Figure 10).

Two surface water samples will be collected in Borrow Pit Lake in Creek Segment F upstream of the discharge of Dead Creek to assess the effect of backwater conditions and/or the contributions of other sources. One sample will be collected upstream and one sample will be collected downstream of the confluence of Dead Creek and Old Prairie du Pont Creek to evaluate the impact of the Dead Creek discharge on surface water quality in Old Prairie du Pont Creek.

The location of the upstream sample in Old Prairie du Pont Creek will be collected at an appropriate distance from the confluence with Dead Creek so that possible previous effects of flooding and flow reversals will not affect the collection of the background sample. As reported in the 1996 HRS package prepared by PRC Environmental Management, Inc. for USEPA Region V, a background sampling station was located 200 ft north of the confluence of Dead Creek and Old Prairie du Pont Creek. The surface water background sample will be collected at this location.

Samples will be collected at a depth of 0.6 ft of the creek water column (measured from the top of the water column).

Number of Surface Water Samples 20

Analyses	VOCs	USEPA Method 8260B
	SVOCs	USEPA Method 8270C
	Metals	USEPA Method 6010A
	Mercury	USEPA Method 7470A

Cyanide	USEPA Method 9010B
Fluoride	USEPA Method 300.0
Total Phosphorus	USEPA Method 365.4
Ortho-phosphate	USEPA Method 300.0
PCBs	USEPA Method 680
Pesticides	USEPA Method 8081A
Herbicides	USEPA Method 8151A
Dioxin	USEPA Method 8290
TSS	USEPA Method 160.2
TDS	USEPA Method 160.1
Hardness	USEPA Method 130.1/130.2
pH	USEPA Method 150.1/150.2

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Table 23 is a sample and analysis summary of this activity.

5.21.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler containing environmental samples for VOC analysis that is shipped.

5.21.3. Field procedures

Sampling procedures for collecting surface water samples were developed using sample collection techniques, equipment, and materials described in the

USEPA Region V document, *Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (USEPA 1996) as guidance. The degree of protection from sample contamination during collection, transport, and analysis provided in Method 1669 was developed assuming laboratory analytical method detection limits as low as tenths of a part per trillion. At the part per trillion method detection limit, outside contaminants must be eliminated. To this end, stringent and certifiable cleaning of all sampling equipment and materials, non-metallic sample collection materials and containers, and four sample collection techniques are included in the Method 1669.

Analytical methodologies and method detection limits have been developed to meet the objectives of this project and are described and listed in the QAPP. The project method detection limits for metals analyses are 1 to 3 orders of magnitude higher than those in Method 1669. For this reason, many of the requirements of Method 1669 are not applicable to this project. The types of protective gloves, tubing materials, container materials, sampling team members and their responsibilities, and specific sample collection techniques and equipment have been adopted from Method 1669. For this sampling activity, Teflon® tubing, Teflon® barbed hose connectors, styrene/ethylene/butylene/silicone (SEBS) flexible tubing, and laboratory-preserved sample containers will be used.

Samples will be collected using a flat-bottom boat. Sampling equipment will be placed into the boat. Personal flotation devices will be worn by the sampling team. A third team member will remain on shore with the throwable flotation device. Sampling will be performed from downstream to upstream. The boat will be paddled to the first sampling location and anchored in place with the bow facing upwind or upstream as appropriate. Once at the sampling location, clean, non-talc gloves will be put on by both team members. An appropriate length of SEBS tubing will be removed from the roll of tubing and cut. One team member will affix the Teflon® weight to the inlet end of the tubing, and attach the tubing to the 3-ft PVC extension. Enough extra tubing will be used so the inlet can be placed at approximately 0.6x (ft of creek water column, where "x" is the total depth of the water column) measured from the top of the water column. Water depth will be measured and sampling depth established prior to sampling. The PVC extension will be firmly fixed into its holder. The flexible tubing will then be connected to the peristaltic pump head. Sufficient flexible tubing will then be pulled from the roll so the discharge end extends 6 to 12 inches off the stern of the boat. The flexible hose will be fixed to the bottom of the boat with duct tape to minimize tripping hazards. The peristaltic pump will be turned on and operated at an approximate flow rate of 100 ml/min and allowed to pump for 5 minutes to purge the collection tubing. While purging in continuing, sample labels can be completed and affixed to the sample containers. A new pair of non-talc gloves will be put on by both team members and samples will be collected, filling the VOC sample containers first. Metals samples will be collected last.

As a sample container is filled and securely capped, it will be placed on ice in a cooler. Once the sample containers have been filled and placed in the cooler, the chain-of-custody form will be completed. As the chain-of-custody form is being completed, the second team member will disconnect the flexible tubing from the peristaltic pump and extension and place it into a plastic trash bag for disposal. The anchor will then be pulled, the boat will be positioned to collect the next sample, and the sampling procedure will be repeated. Sampling equipment decontamination will follow the procedure described in section 5.7.3.

If, during surface water collection in Dead Creek, it is found that using the boat is not feasible, the samples will be collected from the bank by fixing the inlet end to an extendable, non-metallic rod and holding the inlet in the creek. The discharge end of the tubing will be held in a position to discharge over the creek bank downstream of the inlet.

5.21.4. Documentation

A field notebook will be kept for the surface water sampling. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, sample collection times, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.22. Air sampling

5.22.1. Rationale/design

Ambient air sampling will be conducted to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the human health risk assessment (construction/utility worker and residential exposure scenarios). The Human Health Risk Assessment Work Plan is in Volume 1B of the SSP.

Volatile organics. Twenty-four-hour cumulative duration sorbent tube samples will be collected over a 1-day period using TO-1 (attached as Appendix G) sampling protocols in order to evaluate the tendency of site constituents to enter the atmosphere and local wind patterns. Two upwind and two downwind sorbent tube samplers will be installed around Site G, and three upwind and six downwind sorbent tube samplers will be installed at Sites H, I, and L. Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Number of Volatile Organic Air Samples 13

Analyses	VOCs	USEPA Method TO-1

Semivolatile organics, PCBs, and dioxins. Twenty-four-hour cumulative duration polyurethane foam (PUF) samples will be collected over a 1-day period using TO-13, TO-4, and TO-9 (attached as Appendix G) sampling protocols in order to evaluate the tendency of site constituents to enter the atmosphere and local wind patterns. Two upwind and two downwind PUF samplers will be installed around Site G, and three upwind and six downwind PUF samplers will be installed at Sites H, I, and L. Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Number of Semivolatile Organic Air Samples 13

Analyses	SVOCs	USEPA Method TO-13
	PCBs	USEPA Method TO-4
	Dioxin	USEPA Method TO-9

Metals. Twenty-four-hour cumulative duration PM 2.5 samples will be collected over a 1-day period in order to evaluate the tendency of site constituents to enter the atmosphere and local wind patterns. Two upwind and two downwind PM 2.5 samplers will be installed around Site G, and three upwind and six downwind PM 2.5 samplers will be installed at Sites H, I, and L. Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

Number of Metals Air Samples		13
Analyses	Metals	USEPA Method 6010B

Degree of hazard. Organic and inorganic constituents detected will be compiled into a data base. Frequency of detection, average, maximum, minimum and 95% confidence interval concentrations will be compiled for each detected constituent along with information on degree of hazard. This information will be used in the human health risk assessment. The Human Health Risk Assessment Work Plan is in Volume 1B of the SSP.

Ambient air sample collection is required to measure airborne levels of VOCs, SVOCs, PCBs, dioxin, and metals that may be evolving from the site. An air sample collection and analytical test method is required to measure airborne constituent levels over a 24-hour time period. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a very warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet (scf) to collect a quantity of SVOCs that meet the level of detection required by USEPA Region V.

The sample collection method to meet the above requirements for SVOCs measurement is USEPA Method TO-13 as identified in *Compendium of Methods for the Determination of Toxic Organic Compcunds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc. high volume air sampling unit for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs.

The sample collection method for VOC measurement is USEPA Method TO-1. The sampling method for PCB measurement is USEPA Method TO-4. The sampling method for dioxin measurement is USEPA Method TO-9. The sampling method for metals measurement is PM 2.5.

Table 24 is a sample and analysis summary of this activity.

5.22.2. QA/QC samples

QA/QC samples will consist of one duplicate per ten, or fraction of ten, environmental samples collected and one MSD/MSD or spike duplicate per twenty, or fraction of twenty, environmental samples collected. Duplicate, MS/MSD, and spike duplicate samples will be submitted for analysis. Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD and spike duplicate samples are collected to measure laboratory quality control procedures. A field blank (or equipment blank) must be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples. A trip blank for VOC analysis will be included with each sample cooler shipped.

5.22.3. Field procedures

Sample collection will consist of placing sorbent tube samplers, PUF samplers, and PM 2.5 samplers at upwind and downwind locations for Sites G, H, I, and L. Sample positioning will be located in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee. Since no local power supply is readily available at the sites, gasoline- or diesel-powered generators to supply electricity for the samplers will be positioned at downwind locations from the sample collection positions. Wind direction and velocity readings will be obtained and recorded.

Sample collection protocols will follow instruction identified in methods TO-1, TO-4, TO-9, and TO-13 for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample forms will be those provided in the above-stated methods.

5.22.4. Documentation

A field notebook will be kept for the air sampling. Documentation will consist of filling out the forms identified in Methods TO-1, TO-4, TO-9, and TO-13. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, sample collection times, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site. Notation of USEPA Region V acceptance of sampling locations will be included in the field notebook.

5.23. Pilot test sampling

5.23.1. Rationale/design

Treatability pilot tests will be conducted on wastes and sediments in order to identify any characteristics of these materials that would prevent their treatment using off-site incineration or on-site thermal desorption.

Stabilization treatability pilot tests will be conducted to evaluate the efficacy of stabilization technologies to reduce metals and/or organics leaching.

Leachate treatability pilot testing will be conducted to evaluate the appropriate combination of physical/chemical and/or biological treatment processes that are needed to achieve pretreatment requirements for discharge to the American

Bottoms publicly owned treatment works (POTW). Leachate from Sites G and I is considered representative of leachate found in the fill areas.

Off-site waste incineration. One composite organic waste sample will be made from the waste samples collected from the waste characterization borings installed at each fill area (Sites G, H, I, L, and N). Individual aliquots of this sample will be sent to four RCRA/TSCA-permitted, fixed-facility incinerators for waste profiling, material handling characterization, and evaluation of the feasibility of disposing of the waste material by off-site incineration. Current plans call for sending two aliquots to the SafetyKleen facilities at Deer Park, Texas and Coffeyville, Kansas or to a testing location designated by SafetyKleen. SafetyKleen in Coffeyville, Kansas is the only incineration facility permitted to accept dioxin-containing materials from RCRA-listed processes. Two aliquots will be sent to the Waste Management incinerators at Sauget, Illinois and Port Arthur, Texas or to a testing facility designated by Waste Management. These four facilities are the fixed-facility hazardous waste incinerators closest to Sauget Area 1.

On-site waste thermal desorption. One composite organic waste sample will be made from the waste samples collected from the waste characterization borings installed at each fill area (Sites G, H, I, L, and N). Aliquots of this sample will be sent to three RCRA/TSCA-permitted thermal desorption contractors for waste profiling, material handling characterization, and evaluation of the feasibility of treating the waste material by thermal desorption. Consolidations and bankruptcies in the environmental services market make it unclear who has mobile thermal desorption equipment permitted to handle PCBs and dioxin. In the past, Canonie, McLaren/Hart, SRS and Weston had thermal desorbers designed to operate in a low-oxygen or oxygen-free mode. Research will be conducted to evaluate who is still in the pyrolitic thermal desorption business and who has a nation-wide permit to handle PCB and dioxin-containing materials. Contractors will be identified to USEPA Region V 30 days before the pilot test samples are shipped.

On-site sediment thermal desorption. Sediment samples will be collected every 200 ft in Creek Segment B and at ten locations in Site M to create one composite sediment sample to be used in the sediment on-site thermal desorption pilot treatability testing. Aliquots of this sample will be sent to three RCRA/TSCA-permitted thermal desorption contractors for waste profiling, material handling characterization, and evaluation of the feasibility of treating the waste material by thermal desorption. Consolidations and bankruptcies in the environmental services market make it unclear who has mobile thermal desorption equipment permitted to handle PCBs and dioxin. In the past, Canonie, McLaren/Hart, SRS and Weston had thermal desorbers designed to operate in a low-oxygen or oxygen-free mode. Research will be conducted to evaluate who is still in the pyrolitic thermal desorption business and who has a nation-wide permit to handle PCB and dioxin-containing materials. Contractors will be identified to USEPA 30 days before the pilot test samples are shipped.

Sediment stabilization. One sediment sample will be collected at the sampling station with the highest detected organic concentration, and one sediment sample will be collected the sampling station with the highest detected metal concentration. Stabilization mix testing treatability pilot tests will be conducted on the two samples to evaluate stabilant mixes that will: 1) solidify sediments to pass the paint filter test, 2) solidify sediments to a bearing capacity of 2000 pounds per square foot, and/or 3) reduce metals or organics leaching. Stabilization mix testing will be done by Kiber Environmental Services, Atlanta, Georgia.

Leachate treatment. Leachate treatability pilot tests will be conducted on samples collected from Sites G and I to evaluate if pretreatment limits can be achieved prior to discharge to the American Bottoms POTW. One leachate sample will be collected from Site I, and one leachate sample will be collected from Site G using the 2-inch diameter well installed at each of these fill areas as part of the Waste Characterization Sampling Plan. As directed by USACE, these wells will be stressed so that a representative leachate sample can be collected. Pumping will be limited by constraints imposed by leachate storage and disposal requirements. Pilot treatability testing will be conducted by the ADVENT Group, Brentwood, Tennessee.

5.23.2. Field procedures

Fill area. The borings will be advanced using conventional hollow stem auger drilling methods. Samples will be collected using a 5-ft continuous sampler. The 5-ft samples will be split and placed into sealable 5-gal buckets for shipment to treatment facilities. This procedure will be repeated for the depth of the boring (approximately forty feet).

Sediment thermal desorption. Creek sediment samples will be collected following procedures outlined in section 5.20.1 Samples will be composited into a sealable 5-gal bucket.

Sediment stabilization. Sediment samples will be collected following the procedures outlined in section 5.20.1. Kiber Environmental Services will be contacted to establish sample quantity requirements.

Leachate sample. Leachate samples will be collected generally following procedures outlined in section 5.7.3. Wells will be pumped at a rate that allows continuous discharge without drying up the well, and sufficient volume will be pumped to enable water from at least 1 ft away from the filter pack to be drawn into the well before a sample is collected. For an 8-inch diameter borehole, a 2-ft long screen, and a porosity of 0.3, this volume is approximately 25 gal of leachate. The ADVENT Group will be contacted to establish sample quantity and container requirements.

5.23.4. Documentation

A field notebook will be kept for the pilot test sampling activity. At a minimum, the field notebook will include the project name and number, date and time, weather conditions, sampler's name, sample location, limiting field conditions, problems encountered, subcontractor personnel on-site, USEPA Region V personnel on-site, and other personnel on-site.

6. Field operations documentation

The field sampling team will maintain a set of field notebooks. Forms that will be used include: chain-of-custody, test boring log, and ground water sampling log. The appendices contain copies of these forms.

The field notebooks will contain tabulated results of field measurements and documentation of field instrument calibration activities. The field notebooks will also record the following:

- Personnel conducting the site activities, their arrival and departure times, and their destination at the site
- Incidents and unusual activities that occur on the site such as, but not limited to, accidents, breaches of security, injuries, equipment failures, and weather related problems
- Changes to the FSP and the HASP
- Daily information such as:
  - Work accomplished and the current site status
  - Equipment calibrations, repairs and results.
  - Site work zones.

In the field sampler's individual bound field notebook, samplers will note, with permanent ink, meteorological data, equipment employed for sample collection, calculations, information regarding collection of QA/QC samples, and any observations. All entries will be signed and dated, and any entry which is to be deleted will have a single cross out which is signed and dated. The following sampling-related information will be recorded in the field notebook by the field sampling team:

- Project name and number
- Sample number
- Sampling location
- Required analysis
- Date and time of sample collection
- Type and matrix of sample
- Sampling technique
- Preservative used, if applicable

- Sampling conditions
- Observations
- Initials of the sampler.

Field data documentation procedures will be minimal in scope. Only direct reading instrumentation will be employed in the field. The use of pH, conductivity, and turbidity meters; a photoionization detector (PID); a real time aerosol monitor (RAM); and thermometers will generate some measurements directly read from the meters following calibration by the respective manufacturer's recommendations. Such data will be written into field notebooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed, and dated by the field member, and corrected in a space adjacent to the original entry. Later, when the results forms are filled out, the O'Brien & Gere Field Leader will proof the forms to assess whether transcription errors have been made.

Photographic records will be developed through the use of digital photographs showing pre-sampling and post-sampling conditions at each site and of the test trenches.

6.1. Sample documentation

6.1.1. Sample identification system

The sample identification system will involve the following:

- Soil gas survey data will be labeled SG-G-1 where "SG" denotes soil gas survey, "G" is the site designation, and "1" denotes a sequential sample number.

- Waste samples will be labeled WASTE-G-___FT where "WASTE" denotes a waste sample, "G" is the site designation, and "___FT" indicates sample depth, which is filled in by the sampler.

- Fill area and upgradient ground water samples will be labeled using the well name (*e.g.*, EEG-107)

- Alluvial aquifer samples will be labeled AA-I-S1-___FT where "AA" denotes an alluvial aquifer sample, "I" is the site designation, "S1" is the sequentially numbered sampling station, and "___FT" indicates sample depth, which is filled in by the sampler.

- Bedrock ground water samples will be labeled BR-1 and BR-2 where "BR" denotes a bedrock ground water sample and "1" and "2" denote sequential numbers.

- Shallow ground water samples will be labeled SGW-S1-___FT where "SGW" denotes a shallow ground water sample, "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Time series ground water samples will be labeled TS-S1-___HR where "TS" denotes a time series sample, "S1" is the sequentially numbered sampling location, and "___HR" indicates sample time, which is filled in by the sampler.

- Domestic well samples will be labeled DW-ABCD-1 where "DW" denotes a domestic well sample, "ABCD" denotes the first four letters of the well owner's last name, and "1" denotes a sequential sample number.

- Undeveloped area soil samples will be labeled UAS-T1-S1-___FT where "UAS" denotes an undeveloped area soil sample, "T1" is the transect number, "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Developed area soil samples will be labeled DAS-T1-S1-___FT where "DAS" denotes a developed area soil sample, "T1" is the transect number "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Background soil samples collected near wells will be labeled BS-EE20-___FT where "BS" denotes a background soil sample, "EE20" is the well location adjacent to the soil sample, and "___FT" indicated sample depth, which is filled in by the sampler.

- Undeveloped area sediment samples will be labeled BSSED-CSA-S1-___FT where "BSSED" denotes a broad-scan sediment sample, "CSA" designates Dead Creek sector, "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Developed area sediment samples will be labeled FASED-CSA-S1-___FT where "FASED" denotes a focused analysis sediment sample, "CSA" designates Dead Creek sector, "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Borrow Pit Lake sediment samples will be labeled "BPLSED-S1-___FT where "BPLSED" denotes a sediment sample from Borrow Pit Lake, "S1" is the sequentially numbered sampling location and "___FT" indicates sample depth, which is filled in by the sampler.

- Dead Creek sediment samples will be labeled SED-CSA-S1-___FT where "SED" denotes a sediment sample, "CSA" designates the Dead Creek sector, "S1" is the sequentially numbered sampling location, and "___FT" indicates sample depth, which is filled in by the sampler.

- Surface water samples will be labeled SW-CSA-S1 or SW-BPL-S1, where "SW" denotes a surface water sample, "CSA" or "BPL" designate Dead Creek sector or Borrow Pit Lake, respectively,, and "S1" is the sequentially numbered sampling location.

- Air samples will be labeled AIR-V-1, AIR-S-1, or AIR-M-1 where "AIR" denotes an air sample, "V", "S", or "M" designate a VOC, SVOC, or metals sample, respectively, and "1" denotes a sequential sample number.

- Incineration pilot test samples will be labeled WI-G-1 where "WI" denotes a waste sample for incineration testing, "G" is the site designation, and "1" denotes a sequential sampling number.

- Waste thermal desorption pilot test samples will be labeled WTD-G-1 where "WTD" denotes a waste sample for thermal desorption testing, "G" is the site designation, and "1" denotes a sequential sample number.

- Sediment thermal desorption pilot test samples will be labeled STD-CSB-1 and STD-M-1 where "STD" denotes a sediment sample for thermal desorption testing, "CSB" or "M" designates Dead Creek Sector B or Site M, respectively, and "1" denotes a sequential sample number.

- Sediment stabilization pilot test samples will be labeled SS-S1-1 where "SS" denotes a sediment sample for stabilization testing, "S1" is the sequentially numbered sampling station, and "1" denotes a sequential sample number.

- Leachate pilot test samples will be labeled LEACH-I-1 where "LEACH" denotes a leachate sample for testing, "I" is the site designation, and "1" denotes a sequential sample number.

- "MS/MSD" or "DUP" at the end of a sample identification will indicate a matrix spike/matrix spike duplicate or a duplicate sample, respectively.

6.1.2. Sample labels

For proper identification in the field and proper tracking by the analytical laboratory, samples will be labeled in a clear and consistent fashion. Sample labels will be waterproof, or sample containers will be sealed in plastic bags. Field personnel will maintain a sampling log sheet containing information sufficient to allow reconstruction of the sample collection and handling procedures at a later time.

A completed sample tag and sample label will each be attached to each investigative or QC sample. The following will be recorded with permanent ink on sample tags and labels by the field sampling team:

- Project name and number
- Sample number identification
- Initials of sampler
- Sampling location (if not already encoded in the sample number)
- Required analysis
- Date and time of sample collection
- Space for laboratory sample number (only on the sample tag).
- Preservative used, if applicable.

6.1.3. Chain-of-custody records

Chain-of-custody procedures will be instituted and followed throughout the sampling activities. Samples are physical evidence and will be handled according to strict chain-of-custody protocols. The field sampler is personally responsible for the care and custody of the sample until transferred. For proper identification in the field and proper tracking by the analytical laboratory, samples will be labeled in a clear and consistent fashion.

The following information will be recorded on the chain-of-custody by the field sampling team:

- Project name and number
- Sample description/location
- Required analysis
- Date and time of sample collection
- Type and matrix of sample
- Number of sample containers
- Analysis requested/comments
- Sampler signature/date/time.
- Air bill number.

The laboratory will assign a number for each sample upon receipt. That sample number will be placed on the sample tag and sample label. Both tag and label will be attached to the sample container.

A chain-of-custody document providing all information, signatures, dates, and other information, as required on the example chain-of-custody form in Appendix A, will be completed by the field sampler and provided for each sample cooler. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the chain-of-custody. The field sampler will sign the chain-of-custody form when relinquishing custody, make a copy to keep with the field notebook, and include the original form in an air-tight plastic bag in the sample cooler with the associated samples.

6.2. Field analytical records

Field analytical records for the Support Sampling Project will consist of gas chromatograms from the field gas chromatograph used in the soil gas survey, and field notebook entries for field instruments. Chromatograms will be taped into an analytical notebook. In addition to information printed on the chromatograms, field notes will be added as appropriate. Information detailed on each chromatogram will include:

- Sample number identification
- Initials of sampler
- Sampling location (if not already encoded in the sample number)

- Required analysis
- Date and time of sample collection
- Date and time of analysis
- Instrument name
- Column and detector type
- Carrier gas and flowrate
- Backflush time
- Injection volume
- Gain setting.

Only direct reading instrumentation will be employed in the field. The use of pH, conductivity, and turbidity meters, a photoionization detector (PID), a real time aerosol monitor (RAM), and thermometers will generate some measurements directly read from the meters following calibration by the respective manufacturer's recommendations. Such data will be written into field notebooks immediately after measurements are taken. Calibration records will also be recorded in the notebooks.

6.3. Data management and retention

The field data and documentation as described in this section will become a part of the final evidence file. The final evidence file will be the central repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this FSP and the QAPP. O'Brien & Gere is the custodian of the evidence file and maintains the contents of evidence files for the site, including all relevant records, reported, logs, field notebooks, pictures, subcontractor reports, data reviews, and the database management system.

Upon completion of the analyses, the project O'Brien & Gere QAO will begin assimilating the field and laboratory notes. In this way, the file for the samples will be generated. The final file for the sample will be stored at O'Brien & Gere and will consist of the following:

- Laboratory data packages, including summary and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, work sheets, and sample preparation notebooks
- Chain-of-custody records
- Data validation reports.

The following documentation will supplement the chain-of-custody records:

- Field notebooks and data
- Field collection report
- Photographs and drawings
- Progress and QA reports
- Contractor and subcontractor reports
- Correspondence.

The evidence file must be maintained in a secured, limited access area until all submittals for the project have been reviewed and approved, and for a minimum of six years past the submittal date of the final report.

7. Personal protective equipment

Personal protective equipment (PPE) requirements for each level of protection for O'Brien & Gere personnel are described in the HASP prepared for these field activities.

7.1. Protective equipment selection

Initial levels of PPE will be as shown in the following table

Activity	Level B	Level C	Modified Level D	Level D
Trenching		Observation		
Soil Gas Sampling		Initial		
Magnetometer Survey			Initial	
Installation of soil borings and collection of cuttings		Initial		
Ground water sampling at existing wells		Initial		
Installation and sampling of ground water wells		Initial		
Domestic Water Sampling				Initial
Surface and subsurface soil sampling		Area G	Initial	
Surface water and sediment sampling			Initial	
Air sampling				Initial

8. Sample packaging and shipping

A completed sample tag and sample label will each be attached to each investigative or QC sample and the sample placed in a shipping container. Information to be recorded on sample tags and labels is described in section 6.1.2. Information to be recorded on chain-of-custody forms is described in section 6.1.3. The sample identification system used in the field is described in section 6.1.1.

Sampling containers will be packed in styrofoam sheets and put in plastic bags to help prevent breakage and cross-contamination. Samples will be shipped in coolers, each containing a chain-of-custody form and ice and ice packs to maintain inside temperature at approximately 4 °C. Sample coolers will then be sealed between the lid and sides of the cooler with a custody seal prior to shipment. The custody seal will be an adhesive-backed tape that easily rips if it is disturbed. Samples will be shipped to the laboratory by common overnight carrier or will delivered by O'Brien & Gere. The field sampling team will send sample coolers to Savannah Labs. For samples collected for dioxin and dibenzofuran analysis, samples will be sent to Triangle Labs. Samples will not be sent to another laboratory without the permission of USEPA Region V. Sample transportation will comply with U.S. Department of Transportation and ICAO/IATA (1999) regulations. Special sampling packing provisions will be made for samples requiring additional protection.

Samples will remain in the custody of the sampler until transfer of custody is completed. Transfer consists of:

- Delivery of samples to the laboratory sample custodian
- Signature of the laboratory sample custodian on the chain-of-custody document as receiving the samples and signature of sampler as relinquishing the samples.

If a carrier is used to take samples between the sampler and the laboratory, a copy of the air bill must be attached to the chain-of-custody to maintain proof of custody.

9. Investigation-derived wastes

Sampling activities will occur in widely-separated locations. Therefore, personnel and equipment decontamination will be accomplished at each sampling area using temporary facilities. Chapter 8 of the HASP describes personnel and monitoring equipment decontamination procedures and supplies. PPE, disposable sampling equipment, cuttings, purge waters, and field decontamination wastes will be collected at the point of generation and stored in temporary containers. PPE, solids, and liquids will be consolidated in separate bulk containers at a central area. The sampling procedures have been developed to minimize the quantity of waste generated. Additional activity-specific information on disposal of investigation-derived wastes is contained in Chapter 5 of this FSP.

10. Field assessment/inspection

The performance audit is an independent check to evaluate the quality of data being generated. The system audit is an on-site review and evaluation of the quality control practices, sampling procedures, and documentation procedures.

At the discretion of the O'Brien & Gere PM, performance and system audits of field activities will be conducted to verify that sampling and analyses are performed in accordance with the procedures established in this FSP and the QAPP. The audits of field activities include two independent parts: internal and external audits.

The internal audits will be performed by the O'Brien & Gere QAO. The external audits will be performed by USEPA Region V.

10.1. Field performance and system audits

10.1.1. Internal field audits

Internal field audit responsibilities. Internal audits of field activities including sampling and field measurements will be conducted by the O'Brien & Gere QAO.

Internal field audit frequency. These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the site sample collection activities and annually thereafter.

Internal field audit procedures. The audits will include examination of field sampling records, field instrumentation operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, and other elements of the field program. Follow up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the project. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The areas of concern in a field audit include:

- Sampling procedures
- Decontamination of sampling equipment, if applicable
- Chain-of-custody procedures
- Standard operating procedures
- Proper documentation in field notebooks.
- Subcontractor procedures.

10.1.2. External field audits

External field audit responsibilities. External field audits may be conducted by USEPA Region V.

External field audit frequency. External field audits may be conducted at any time during the field operations. These audits may or may not be announced and are at the discretion of USEPA Region V.

Overview of the external field audit process. External field audits will be conducted according to the field activity information presented in this FSP and the QAPP.

11. Corrective action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. Corrective action proposed and implemented will be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the O'Brien & Gere PM or the O'Brien & Gere Field Leader. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be developed and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the O'Brien & Gere PM, who in turn will notify USEPA Region V. Implementation of corrective action will be confirmed in writing through the same channels. Nonconformance with the established quality control procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. USEPA Region V will issue a nonconformance report for each nonconformance condition.

11.1. Field corrective action

Corrective action in the field can be needed when the sample network is changed (*i.e.*, more or less samples, sampling location changes, and related modifications) or sampling procedures and/or field analytical procedures require modification due to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the O'Brien & Gere Field Leader. The O'Brien & Gere Field Leader will be responsible for assessing the suspected problems in consultation with the O'Brien & Gere PM on making a decision based on the potential for the situation to impact the quality of the data. If it is decided the situation requires a reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the O'Brien & Gere PM.

The O'Brien & Gere PM will be responsible for verifying corrective actions for nonconformance are initiated by:

- Evaluating reported nonconformances
- Controlling additional work on nonconforming items
- Identifying disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Verifying nonconformance reports are included in the final site documentation in project files

If appropriate, the O'Brien & Gere Field Leader will verify no additional work dependent on the nonconforming activity is performed until the corrective actions are completed. Corrective action for field measurements may include:

- Repeat the measurement to check the error
- Check for proper adjustments for ambient conditions such as temperature
- Check the batteries
- Re-calibration
- Check the calibration
- Replace the instrument or measurement devices
- Stop work (if necessary).

The O'Brien & Gere Field Leader is responsible for site activities. In this role, the O'Brien & Gere Field Leader at times is required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the O'Brien & Gere Field Leader of the anticipated change and implements the necessary changes after obtaining the approval of the O'Brien & Gere Field Leader. The change in the program will be documented on the field change request (FCR) that will be signed by the initiators and the O'Brien & Gere Field Leader. The FCR for each document will be numbered serially as required. The FCR will be attached to the file copy of the affected document. The O'Brien & Gere Field Leader must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated in order to evaluate the significance of any departure from established program practices and action taken.

The O'Brien & Gere Field Leader is responsible for controlling, tracking, and implementing identified changes. Reports on changes will be distributed to affected parties, which includes USEPA Region V.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The O'Brien & Gere QAO will identify deficiencies and recommend corrective action to the O'Brien & Gere PM. Implementation of corrective actions will be performed by the O'Brien & Gere Field Leader and the field team. Corrective action will be documented in the quality assurance report to the project management.

Corrective actions will be implemented and documented in the field notebook. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by USEPA Region V.

The O'Brien & Gere QAO and Laboratory QAO may identify the need for corrective action during either the data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection or reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team or whether the data to be collected is necessary to meet the required quality assurance objectives. When the O'Brien & Gere QAO or Laboratory QAO identifies a corrective action situation, it is the O'Brien & Gere PM who will be responsible for approving the implementation of corrective action, including resampling, during data assessment. Corrective actions of this type will be documented by the O'Brien & Gere QAO and the Laboratory QAO.

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TABLES

Ta. Fill Area Soil Gas Survey - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size,type)	Preservation	Holding Time	Total Analyses
G	Soil Gas	VOC-Field GC 3810 [1]	6 min 18 max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min 6 max 18
H	Soil Gas	VOC-Field GC 3810 [1]	8 min 20 max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min 8 max 20
I	Soil Gas	VOC-Field GC 3810 [1]	12 min 24 max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min 12 max 24
L	Soil Gas	VOC-Field GC 3810 [1]	1 min 13 max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min 1 max 13
N	Soil Gas	VOC-Field GC 3810 [1]	2 min 14 max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min 2 max 14
Total Samples			29 min 89 max	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	min 29 max 89

[1] Static headspace analysis, closely parallels USEPA Method 3810

Table 2 Fill Area Waste Sampling Borings - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time to 1311 extract/ to extraction/ to analysis	Total Analyses
G	Waste	Ignitability 1010/1020A	4		0	0	0	1 - 100 ml plastic	4°C	As soon as possible	4
		Corrosivity 1110	4		0	0	0	container			4
		Reactivity-9014	4		0	0	0				4
		VOC-1311/5035/8260B	4	1	0	0	4	4-25 gm En-Core[1]	4°C	48 Hours/14/14days	9
		SVOC-1311/8270C	4	1	0	0	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/7/40 days	5
		Metals-1311/6010B	4	1	0	0	0	1-4 oz widemouth	4°C	180/---/180 days	5
		Mercury-1311/7471A	4	1	0	0	0	polyethylene or glass		28/---/28 days	5
		Cyanide-9010B	4	1	0	0	0	1-4oz wide mouth amber glass with Teflon lined lid	4°C	14 days	5
		PCBS - 680	4	1	0	0	0	1-500 ml, wide mouth glass with Teflon lined lid	4°C	---/14/40 days	5
		Pesticides-1311/8081A	4	1	0	0	0	1-250 ml, wide mouth	4°C	14/14/40 days	5
		Herbicides-1311/8151A	4	1	0	0	0	glass with Teflon lined lid			5
		Dioxin-1311/8280A	4	1	0	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	5
H	Waste	Ignitability -1010/1020A	4	0	0	0	0	1-100 ml plastic	4°C	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0	container			4
		Reactivity 9014	4	0	0	0	0				4
		VOC-1311/5035/8260B	4	1	1	0	4	4-25 gm En-Core[1]	4°C	48 Hours/14/14days	10
		SVOC-1311/8270C	4	1	1	0	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/7/40 days	6
		Metals-1311/6010B	4	1	1	0	0	1-4 oz widemouth	4°C	180/---/180 days	6
		Mercury-1311/7471A	4	1	1	0	0	polyethylene or glass		28/---/28 days	6
		Cyanide-9010B	4	1	1	0	0	1-4oz wide mouth amber glass with Teflon lined lid	4°C	14 days	6
		PCBS - 680	4	1	1	0	0	1-500 ml, wide mouth glass with Teflon lined lid	4°C	---/14/40 days	6
		Pesticides-1311/8081A	4	1	1	0	0	1-250 ml, wide mouth	4°C	14/14/40 days	6
		Herbicides 1311/8151A	4	1	1	0	0	glass with Teflon lined lid			6
		Dioxin-1311/8280A	4	1	1	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	6

Table 2 rea Waste Sampling Borings - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time to 1311 extract/ to extraction/ to analysis	Total Analyses
I	Waste	Ignitability -1010/1020A	4	0	0	0	0	1-100 ml plastic container	$4^{\circ}C$	As soon as possible	4
		Corrosivity 1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-1311/5035/8260B	4	1	0	1	4	4-25 gm En-Core[1]	$4^{\circ}C$	48 Hours/14/14days	10
		SVOC-1311/8270C	4	1	0	1	0	1-250 ml wide mouth glass w/Teflon lined lid	$4^{\circ}C$	14/7/40 days	6
		Metals-1311/6010B	4	1	0	1	0	1-4 oz widemouth polyethylene or glass	$4^{\circ}C$	180/---/180 days	6
		Mercury-1311/7471A	4	1	0	1	0			28/---/28 days	6
		Cyanide-9010B	4	1	0	1	0	1-4oz wide mouth amber glass with Teflon lined lid	$4^{\circ}C$	14 days	6
		PCBS - 680	4	1	0	1	0	1-500 ml, wide mouth glass with Teflon lined lid	$4^{\circ}C$	---/14/40 days	5
		Pesticides-1311/8081A	4	1	0	1	0	1-250 ml, wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/14/40 days	5
		Herbicides-1311/8151A	4	1	0	1	0				5
		Dioxin-1311/8280A	4	1	0	1	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	$4^{\circ}C$	30/45 days	6
L	Waste	Ignitability -1010/1020A	4		0	0	0	1-100 ml plastic container	$4^{\circ}C$	As soon as possible	4
		Corrosivity-1110	4		0	0	0				4
		Reactivity-9014	4		0	0	0				4
		VOC-1311/5035/8260B	4	1	1	0	4	4-25 gm En-Core[1]	$4^{\circ}C$	48 Hours/14/14days	10
		SVOC-1311/8270C	4	1	1	0	0	1-250 ml wide mouth glass w/Teflon lined lid	$4^{\circ}C$	14/7/40 days	6
		Metals-1311/6010B	4	1	1	0	0	1-4 oz widemouth polyethylene or glass	$4^{\circ}C$	180/---/180 days	6
		Mercury-1311/7471A	4	1	1	0	0			28/---/28 days	6
		Cyanide-9010B	4	1	1	0	0	1-4oz wide mouth amber glass with Teflon lined lid	$4^{\circ}C$	14 days	6
		PCBS - 680	4	1	1	0	0	1-500 ml, wide mouth glass with Teflon lined lid	$4^{\circ}C$	---/14/40 days	5
		Pesticides-1311/8081A	4	1	1	0	0	1-250 ml, wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/14/40 days	5
		Herbicides-1311/8151A	4	1	1	0	0				5
		Dioxin-1311/8280A	4	1	1	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	$4^{\circ}C$	30/45 days	6

Table 2 Fill Area Waste Sampling Borings - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time to 1311 extract/ to extraction/ to analysis	Total Analyses
N	Waste	Ignitability -1010/1020A	4	0	0	0	0	1-100 ml plastic container	4°C	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity 9014	4	0	0	0	0				4
		VOC-1311/5035/8260B	4	1	0	1	4	4-25 gm En-Core[1]	4°C	48 Hours/14/14days	10
		SVOC-1311/8270C	4	1	0	1	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/7/40 days	6
		Metals-1311/6010B	4	1	0	1	0	1-4 oz widemouth polyethylene or glass	4°C	180/---/180 days	6
		Mercury-1311/7471A	4	1	0	1	0			28/---/28 days	6
		Cyanide-9010B	4	1	0	1	0	1-4oz wide mouth amber glass with Teflon lined lid	4°C	14 days	6
		PCBS - 680	4	1	0	1	0	1-500 ml, wide mouth glass with Teflon lined lid	4°C	---/14/40 days	5
		Pesticides-1311/8081A	4	1	0	1	0	1-250 ml, wide mouth glass with Teflon lined lid	4°C	14/14/40 days	5
		Herbicides-1311/8151A	4	1	0	1	0				5
		Dioxin-1311/8280A	4	1	0	1	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	6
M	Sediment	Ignitability -1010/1020A	4	1	0	0	0	1-100 ml plastic container	4°C	As soon as possible	4
		Corrosivity-1110	4	1	0	0	0				4
		Reactivity-9014	4	1	0	0	0				4
		VOC-1311/5035/8260B	4	1	1	0	4	4-25 gm En-Core[1]	4°C	48 Hours/14/14days	10
		SVOC-1311/8270C	4	1	1	0	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/7/40 days	6
		Metals-1311/6010B	4	1	1	0	0	1-4 oz widemouth polyethylene or glass	4°C	180/---/180 days	6
		Mercury-1311/7471A	4	1	1	0	0			28/---/28 days	6
		Cyanide-9010B	4	1	1	0	0	1-4oz wide mouth amber glass with Teflon lined lid	4°C	14 days	6
		PCBS - 680	4	1	1	0	0	1-500 ml, wide mouth glass with Teflon lined lid	4°C	---/14/40 days	5
		Pesticides-1311/8081A	4	1	1	0	0	1-250 ml, wide mouth glass with Teflon lined lid	4°C	14/14/40 days	5
		Herbicides-1311/8151A	4	1	1	0	0				5
		Dioxin-1311/8280A	4	1	1	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	6
Total Samples			288	54	27	18	24				411

[1] or [illegible]le will be preserved in accordance with USEPA Method 5035

Table 3 Fil' 'Waste Sampling, Surface Soils - Sample and Analysis Summary

Site	M.	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matri.. Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Analyses
G	Soil	Ignitability -1010/1020A	4	0	0	0	0	1-250 ml glass container with Teflon lined lid	4°C	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-5035/8260B	4	1	1	0	4	3- 5 gm En-Core[1]	4°C	48 hrs /14 days	10
		SVOC-8270C	4	1	1	0	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	6
		Metals-6010B	4	1	1	0	0	1-4 oz widemouth polyethylene or glass	4°C	180 days	6
		Mercury-7471A	4	1	1	0	0			28 days	6
		Cyanide-9010B	4	1	1	0	0	1-4oz wide mouth amber glass with Teflon lined lid	4°C	14 days	6
		PCB - 680	4	1	1	0	0	1 - 500 ml wide mouth glass with Teflon lined lid	4°C	14/40 days	6
		Pesticides-8081A	4	1	1	0	0	1 - 250 ml wide mouth glass with Teflon lined lid	4°C	14/40 days	6
		Herbicides-8151A	4	1	1	0	0				6
		Dioxin - 8280A	4	1	1	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	6
H	Soil	Ignitability -1010/1020A	4	0	0	0	0	1-250 ml glass container with Teflon lined lid	4°C	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-5035/8260B	4	1	0	1	4	3- 5 gm En-Core[1]	4°C	48 hrs /14 days	10
		SVOC-8270C	4	1	0	1	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	6
		Metals-6010B	4	1	0	1	0	1-4 oz widemouth polyethylene or glass	4°C	180 days	6
		Mercury-7471A	4	1	0	1	0			28 days	6
		Cyanide-9010B	4	1	0	1	0	1-4oz wide mouth amber glass with	4°C	14 days	6
		PCB - 680	4	1	0	1	0	1 - 500 ml wide mouth glass with Teflon lined lid	4°C	14/40 days	6
		Pesticides-8081A	4	1	0	1	0	1 - 250 ml wide mouth glass with Teflon lined lid	4°C	14/40 days	6
		Herbicides-8151A	4	1	0	1	0				6
		Dioxin - 8280A	4	1	0	1	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	6

Table 3 Fill Area Waste Sampling, Surface Soils - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
I	Soil	Ignitability -1010/1020A	4	0	0	0	0	1-250 ml glass container with Teflon lined lid	$4^{\circ}C$	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-5035/8260B	4	1	1	0	4	3- 5 gm En-Core[1]	$4^{\circ}C$	48 hrs /14 days	10
		SVOC-8270C	4	1	1	0	0	1-250 ml wide mouth glass w/Teflon lined lid	$4^{\circ}C$	14/40 days	6
		Metals-6010B	4	1	1	0	0	1-4 oz widemouth polyethylene or glass	$4^{\circ}C$	180 days	6
		Mercury-7471A	4	1	1	0	0			28 days	6
		Cyanide-9010B	4	1	1	0	0	1-4oz wide mouth amber glass with	$4^{\circ}C$	14 days	6
		PCB - 680	4	1	1 1 1	0 0 0	0 0 0	1 - 500 ml wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/40 days	6
		Pesticides-8081A	4	1	1	0	0	1 - 250 ml wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/40 days	6
		Herbicides-8151A	4	1							6
		Dioxin - 8280A	4	1	1	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	$4^{\circ}C$	30/45 days	6
L	Soil	Ignitability -1010/1020A	4	0	0	0	0	1-250 ml glass container with Teflon lined lid	$4^{\circ}C$	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-5035/8260B	4	1	0	0	4	3- 5 gm En-Core[1]	$4^{\circ}C$	48 hrs /14 days	9
		SVOC-8270C	4	1	0	0	0	1-250 ml wide mouth glass w/Teflon lined lid	$4^{\circ}C$	14/40 days	5
		Metals-6010B	4	1	0	0	0	1-4 oz widemouth polyethylene or glass	$4^{\circ}C$	180 days	5
		Mercury-7471A	4	1	0	0	0			28 days	5
		Cyanide-9010B	4	1	0	0	0	1-4oz wide mouth amber glass with	$4^{\circ}C$	14 days	5
		PCB - 680	4	1	0	0	0	1 - 500 ml wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/40 days	5
		Pesticides-8081A	4	1	0	0	0	1 - 250 ml wide mouth glass with Teflon lined lid	$4^{\circ}C$	14/40 days	5
		Herbicides-8151A	4	1	0	0	0				5
		Dioxin - 8280A	4	1	0	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	$4^{\circ}C$	30/45 days	5

Table 3 F Waste Sampling, Surface Soils - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
N	Soil	Ignitability -1010/1020A	4	0	0	0	0	1-250 ml glass container with Teflon lined lid	4°C	As soon as possible	4
		Corrosivity-1110	4	0	0	0	0				4
		Reactivity-9014	4	0	0	0	0				4
		VOC-5035/8260B	4	1	0	0	4	3- 5 gm En-Core[1]	4°C	48 hrs /14 days	9
		SVOC-8270C	4	1	0	0	0	1-250 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	5
		Metals-6010B	4	1	0	0	0	1-4 oz widemouth polyethylene or glass	4°C	180 days	5
		Mercury-7471A	4	1	0	0	0			28 days	5
		Cyanide-9010B	4	1	0	0	0	1-4oz wide mouth amber glass with	4°C	14 days	5
		PCB - 680	4	1	0	0	0	1 - 500 ml wide mouth glass with Teflon lined lid	4°C	14/40 days	5
		Pesticides-8081A	4	1	0	0	0	1 - 250 ml wide mouth glass with Teflon lined lid	4°C		5
		Herbicides-8151A	4	1	0	0	0				5
		Dioxin - 8280A	4	1	0	0	0	100 gm in 1-4 oz amber glass jar with Teflon lined lid	4°C	30/45 days	5
Total Samples			240	45	18	9	20				332

[1] or sample will be preserved in accordance with USEPA Method 5035

Note: surface soils samples to be collected at same locations and prior to starting waste sample collection

Table 4 Fill Areas Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/ Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number, size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
G	Ground Water	VOC-8260B	7	2	1	0	7	3-40 ml vials with Teflon lined septum caps	4°C HCL to pH<2	14 days	17
		SVOC-8270C	7	2	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	10
		Metals-6010B	7	2	1	0	0	1-250 or 500 ml poly or fluorocarbon	HNO_3 to pH<2	180 days	10
		Mercury-7470A	7	2	1	0	0		4°C	28 days	10
		Cyanide-9010B	7	2	1	0	0	1- 250 or 500 ml poly	NaOH to pH>12 4°C	14 days	10
		PCB-680	7	2	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	10
		Pesticides-8081A	7	2	1	0	0	4-1 liter amber glass with Teflon lined screw caps			10
		Herbicides-8151A	7	2	1	0	0				10
		Dioxin-8290	7	2	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	30/45 days	10
H	Ground Water	VOC-8260B	4	1	0	1	5	3-40 ml vials with Teflon lined septum caps	4°C HCL to pH<2	14 days	11
		SVOC-8270C	4	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Metals-6010B	4	1	0	1	0	1-250 or 500 ml poly or fluorocarbon	HNO_3 to pH<2	180 days	6
		Mercury-7470A	4	1	0	1	0		4°C	28 days	6
		Cyanide-9010B	4	1	0	1	0	1- 250 or 500 ml poly	NaOH to pH>12 4°C	14 days	6
		PCB-680	4	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Pesticides-8081A	4	1	0	1	0	4-1 liter amber glass with Teflon lined screw caps			6
		Herbicides-8151A	4	1	0	1	0				6
		Dioxin-8290	4	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	30/45 days	6

Table 4. . [illegible] Areas Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/ Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number, size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
I	Ground Water	VOC-8260B	4	1	1	0	5	3-40 ml vials with Teflon lined septum caps	4°C HCL to pH<2	14 days	11
		SVOC-8270C	4	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Metals-6010B	4	1	1	0	0	1-250 or 500 ml poly	HNO_3 to pH<2	180 days	6
		Mercury-7470A	4	1	1	0	0	or fluorocarbon	4°C	28 days	6
		Cyanide-9010B	4	1	1	0	0	1- 250 or 500 ml poly	NaOH to pH>12 4°C	14 days	6
		PCB-680	4	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Pesticides-8081A	4	1	1	0	0	4-1 liter amber glass with Teflon lined screw caps			6
		Herbicides-8151A	4	1	1						6
		Dioxin-8290	4	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	30/45 days	6
L	Ground Water	VOC-8260B	3	1	0	0	3	3-40 ml vials with Teflon lined septum caps	4°C HCL to pH<2	14 days	7
		SVOC-8270C	3	1	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	4
		Metals-6010B	3	1	0	0	0	1-250 or 500 ml poly	HNO_3 to pH<2	180 days	4
		Mercury-7470A	3	1	0	0	0	or fluorocarbon	4°C	28 days	4
		Cyanide-9010B	3	1	0	0	0	1- 250 or 500 ml poly	NaOH to pH>12 4°C	14 days	4
		PCB-680	3	1	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	4
		Pesticides-8081A	3	1	0	0	0	4-1 liter amber glass with Teflon lined screw caps			4
		Herbicides-8151A	3	1	0	0	0				4
		Dioxin-8290	3	1	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	30/45 days	4

Table 4 Fill Areas Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/ Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number, size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
South of of G	Ground Water	VOC-8260B	1	0	0	0	1	3-40 ml vials with Teflon lined septum caps	4°C HCL to pH<2	14 days	2
		SVOC-8270C	1	0	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	1
		Metals-6010B	1	0	0	0	0	1-250 or 500 ml poly	HNO_3 to pH<2	180 days	1
		Mercury-7470A	1	0	0	0	0	or fluorocarbon	4°C	28 days	1
		Cyanide-9010B	1	0	0	0	0	1- 250 or 500 ml poly	NaOH to pH>12 4°C	14 days	1
		PCB-680	1	0	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	1
		Pesticides-8081A	1	0	0	0	0	4-1 liter amber glass			1
		Herbicides-8151A	1	0	0	0	0	with Teflon lined screw caps			1
		Dioxin-8290	1	0	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	30/45 days	1
Total Samples			171	45	18	9	21				264

Table . ill Area Alluvial Aquifer Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/ Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time Extraction/analysis	Total Analyses
H	Ground Water	VOC-8260B	4	1	1	0	4	3-40 ml glass vials with Teflon lined septum caps	HCL to pH<2 4°C	14 days	10
		SVOC-8270C	4	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Metals-6010B	4	1	1	0	0	1-250 or 500 ml poly	HNO_3 to	180 days	6
		Mercury-7470A	4	1	1	0	0	or fluorocarbon	pH < 2, 4°C	28 days	6
		Cyanide-9010B	4	1	1	0	0	1-250 or 500 ml poly	NaOH to pH >12,4°C	14 days	6
		PCB- 680	4	1	1	0	0	2 -1 liter amber glass with Teflon lined screw cap	4°C	7/40 days	6
		Pesticides-8081A	4	1	1	0	0	4-1 liter amber glass	4°C	7/40 days	6
		Herbicides-8151A	4	1	1	0	0	with Teflon lined screw caps			6
		Dioxin - 8290	4	1	1	0	0	2 - 1 liter amber glas with Teflon lined screw caps	4°C	30/45 days	6
I	Ground Water	VOC-8260B	4	1	0	1	4	3-40 ml glass vials with Teflon lined septum caps	HCL to pH<2 4°C	14 days	10
		SVOC-8270C	4	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	6
		Metals-6010B	4	1	0	1	0	1-250 or 500 ml poly	HNO_3 to	180 days	6
		Mercury-7470A	4	1	0	1	0	or fluorocarbon	pH < 2, 4°C	28 days	6
		Cyanide-9010B	4	1	0	1	0	1-250 or 500 ml poly	NaOH to pH >12,4°C	14 days	6
		PCB- 680	4	1	0	1	0	2-1 liter amber glass with Teflon lined screw cap	4°C	7/40 days	6
		Pesticides-8081A	4	1	0	1	0	4-1 liter amber glass	4°C	7/40 days	6
		Herbicides-8151A	4	1	0	1	0	with Teflon lined screw caps			6
		Dioxin - 8290	4	1	0	1	0	2 - 1 liter amber glas with Teflon lined screw caps	4°C	30/45 days	6
Total Samples			72	18	9	9	8				116

Table 6 Downgradient Alluvial Aquifer Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmen Samples	Number of Field Blank Equipment Blanks	Number Field Duplicat	Number of Matr Spike/Matrix Sp Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
G,H,L	Ground Water	VOC-8260B	30	6	3	2	30	3-40 ml glass vials with Teflon lined septum caps	HCL to pH<2 4°C	14 days	71
		SVOC-8270C	30	6	3	2	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	41
		Metals-6010B	30	6	3	2	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	41
		Mercury-7470A	30	6	3	2	0			28 days	41
		Cyanide-9010B	30	6	3	2	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	41
		PCB - 680	30	6	3	2	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Pesticides-8081A	30	6	3	2	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Herbicides-8151A	30	6	3	2	0				41
		Dioxin-8290	9	3	1	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45	14
I	Ground Water	VOC-8260B	30	6	3	2	30	3-40 ml glass vials with Teflon lined septum caps	HCL to pH<2 4°C	14 days	71
		SVOC-8270C	30	6	3	2	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	41
		Metals-6010B	30	6	3	2	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	41
		Mercury-7470A	30	6	3	2	0			28 days	41
		Cyanide-9010B	30	6	3	2	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	41
		PCB - 680	30	6	3	2	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Pesticides-8081A	30	6	3	2	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Herbicides-8151A	30	6	3	2	0				41
		Dioxin-8290	9	3	1	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45	14

Table 6 Downgradient Alluvial Aquifer Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmen Samples	Number of Field Blank Equipment Blanks	Number Field Duplicat	Number of Matr Spike/Matrix Sp Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
SW of G H,I,L	Ground Water	VOC-8260B	30	6	3	2	30	3-40 ml glass vials with Teflon lined septum caps	HCL to pH<2 4°C	14 days	71
		SVOC-8270C	30	6	3	2	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	41
		Metals-6010B	30	6	3	2	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	41
		Mercury-7470A	30	6	3	2	0			28 days	41
		Cyanide-9010B	30	6	3	2	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	41
		PCB - 680	30	6	3	2	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Pesticides-8081A	30	6	3	2	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	41
		Herbicides-8151A	30	6	3	2	0				41
		Dioxin-8290	9	3	1	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45	14
Total Samples			747	153	75	51	90				1116

Table 7 Bedrock Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
G	Ground Water	VOC-8260B	1	1	0	1	1	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	4
		SVOC-8270C	1	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	3
		Metals-6010B	1	1	0	1	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	3
		Mercury-7470A	1	1	0	1	0			28 days	3
		Cyanide-9010B	1	1	0	1	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	3
		PCB-680	1	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	3
		Pesticides-8081A	1	1	1	0	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	3
		Herbicides-8151A	1	1	1	0	0				3
		Dioxin -8290	1	1	0	1	0	2 - 1 liter amber glass w/ Teflon lined screw caps	4°C	30/45 days	3
H	Ground Water	VOC-8260B	1	1	1	0	1	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	4
		SVOC-8270C	1	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	3
		Metals-6010B	1	1	1	0	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	3
		Mercury-7470A	1	1	1	0	0			28 days	3
		Cyanide-9010B	1	1	1	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	3
		PCB-680	1	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	3
		Pesticides-8081A	1	1	1	0	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	3
		Herbicides-8151A	1	1	1	0	0				3
		Dioxin -8290	1	1	1	0	0	2 - 1 liter amber glass w/ Teflon lined screw caps	4°C	30/45 days	3

Table 7 Bedrock Ground Water Sampling - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
I	Ground Water	VOC-8260B	1	1	0	0	1	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	3
		SVOC-8270C	1	1	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	2
		Metals-6010B Mercury-7470A	1 1	1 1	0 0	0 0	0 0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days 28 days	2 2
		Cyanide-9010B	1	1	0	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	2
		PCB-8082	1	1	0	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	2
		Pesticides-8081A Herbicides-8151A	1 1	1 1	0 0	0 0	0 0	4- 1 liter amber glass w/Teflon lined screw caps			2 2
		Dioxin -8290	1	1	0	0	0	2 - 1 liter amber glass w/ Teflon lined screw caps	4°C	30/45 days	2
Total Samples			27	27	9	9	3				75

Table 8 Shallow Residential Area Ground Water Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Walnut St	Ground Water	VOC-8260B	3	1	1	0	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270C	3	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010B	3	1	1	0	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	5
		Mercury-7470A	3	1	1	0	0			28 days	5
		Cyanide-9010B	3	1	1	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB -680	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	1	0	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Herbicides 8151A	3	1	1	0	0				5
		Dioxin-8290	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	
E Bank Dead Creek at Judith Lane	Ground Water	VOC-8260B	3	1	0	1	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270C	3	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010B	3	1	0	1	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	5
		Mercury-7470A	3	1	0	1	0			28 days	5
		Cyanide-9010B	3	1	0	1	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB - 680	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	0	1	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Herbicides-8151A	3	1	0	1	0				5
		Dioxin-8290	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	5
Total Samples			54	18	9	9	6				96

Table 9 Time Series Ground Water Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Walnut St	Ground Water	VOC-8260B	3	1	1	0	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270C	3	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010B	3	1	1	0	0	1- 250 or 500 ml	HNO3 to	180 days	5
		Mercury-7470A	3	1	1	0	0	poly or fluorocarbon	pH<2, 4°C	28 days	5
		Cyanide-9010B	3	1	1	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB - 680	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	1	0	0	4- 1 liter amber glass	4°C	7/40 days	5
		Herbicides-8151A	3	1	1	0	0	w/Teflon lined screw caps			5
		Dioxin-8290	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	
E. Bank Dead Creek at Judith Lane	Ground Water	VOC-8260B	3	1	0	1	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270C	3	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010B	3	1	0	1	0	1- 250 or 500 ml	HNO3 to	180 days	5
		Mercury-7470A	3	1	0	1	0	poly or fluorocarbon	pH<2, 4°C	28 days	5
		Cyanide-9010B	3	1	0	1	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB - 680	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	0	1	0	4- 1 liter amber glass	4°C	7/40 days	5
		Herbicides-8151A	3	1	0	1	0	w/Teflon lined screw caps			5
		Dioxin-8290	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	5
Total Samples			54	18	9	9	6				96

Table 10 Domestic Well Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Walnut St and Judith Lane	Ground Water	VOC-8260	4	1	1	1	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	10
		SVOC-8270	4	1	1	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	7
		Metals-6010	4	1	1	1	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	7
		Mercury-7470A	4	1	1	1	0			28 days	7
		Cyanide-9010B	4	1	1	1	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	7
		PCB - 680	4	1	1	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	7
		Pesticides-8081A	4	1	1	1	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	7
		Herbicides-8151A	4	1	1	1	0				7
		Dioxin-8290	4	1	1	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	7
Total Samples			36	9	9	9	3				66

Table 11 Grain Size Analysis - Sample and Analysis Summary

Site	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
G	Soil	Sieve/ Hygrometer	3	0	0	0	0	1 to 3, 1 liter plastic depending on soil	none	N/A	3
H	Soil	Sieve/ Hygrometer	3	0	0	0	0	1 to 3, 1 liter plastic depending on soil	none	N/A	3
I	Soil	Sieve/ Hygrometer	3	0	0	0	0	1 to 3, 1 liter plastic depending on soil	none	N/A	3
L	Soil	Sieve/ Hygrometer	3	0	0	0	0	1 to 3, 1 liter plastic depending on soil	none	N/A	3
N	Soil	Sieve/ Hygrometer	3	0	0	0	0	1 to 3, 1 liter plastic depending on soil	none	N/A	3
Total Samples			15								15

N/A---not applicable

Table 12 Upgradient Ground Water Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
EE-20	Ground Water	VOC-8260	3	1	1	0	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270	3	1	1	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010	3	1	1	0	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	5
		Mercury-7470A	3	1	1	0	0			28 days	5
		Cyanide-9010B	3	1	1	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB - 680	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	1	0	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Herbicides-8151A	3	1	1	0	0				5
		Dioxin-8290	3	1	1	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	
EE-04	Ground Water	VOC-8260	3	1	0	1	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	8
		SVOC-8270	3	1	0	1	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	5
		Metals-6010	3	1	0	1	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	5
		Mercury-7470A	3	1	0	1	0			28 days	5
		Cyanide-9010B	3	1	0	1	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	5
		PCB - 680	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Pesticides-8081A	3	1	0	1	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	5
		Herbicides-8151A	3	1	0	1	0				5
		Dioxin-8290	3	1	0	1	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	5

Table 12 Upgradient Ground Water Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
EEG-108	Ground Water	VOC-8260	3	1	0	0	3	3-40 ml glass vials w/Teflon septum caps	HCL to pH<2 4°C	14 days	7
		SVOC-8270	3	1	0	0	0	2-1 liter amber glass with Teflon lined screw caps	4°C	7/40 days	4
		Metals-6010	3	1	0	0	0	1- 250 or 500 ml poly or fluorocarbon	HNO3 to pH<2, 4°C	180 days	4
		Mercury-7470A	3	1	0	0	0			28 days	4
		Cyanide-9010B	3	1	0	0	0	1-250 or 500 ml poly	NaOH to pH>12, 4°C	14 days	4
		PCB - 680	3	1	0	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	4
		Pesticides-8081A	3	1	0	0	0	4- 1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	4
		Herbicides-8151A	3	1	0	0	0				4
		Dioxin-8290	3	1	0	0	0	2- 1 liter amber glass w/Teflon lined screw caps	4°C	30/45 days	4
Total Samples			81	27	9	9	9				135

Table 13 Undeveloped Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
1	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	1	0	0	1 - 4 oz widemouth	4°C	180 days	9
		Mercury-7471A	7	1	1	0	0	poly or fluorocarbon		28 days	9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB - 680	7	1	1	0	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	1	0	0	1 - 250 ml widemouth	4°C	14/40 days	9
		Herbicides-8151A	7	1	1	0	0	glass w/Teflon lined lid			9
		Dioxin-8280	2	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
2	Soil	VOC-5035/8260B	6	1	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	6	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B	6	1	0	1	0	1 - 4 oz widemouth	4°C	180 days	8
		Mercury-7471A	6	1	0	1	0	poly or fluorocarbon		28 days	8
		Cyanide-9010B	6	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB - 680	6	1	0	1	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A	6	1	0	1	0	1 - 250 ml widemouth	4°C	14/40 days	8
		Herbicides-8151A	6	1	0	1	0	glass w/Teflon lined lid			8
		Dioxin-8280	1	1	0	1	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3

Table 13 Undeveloped Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
3	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	1	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	9
		Mercury-7471A	7	1	1	0	0			28 days	9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB - 680	7	1	1	0	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	1	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Herbicides-8151A	7	1	1	0	0				9
		Dioxin-8280	2	1	1	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	4
4	Soil	VOC-5035/8260B	7	1	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	0	1	0	1 - 4 oz widemouth poly or fluorocarbon	4oC	180 days	9
		Mercury-7471A	7	1	0	1	0			28 days	9
		Cyanide-9010B	7	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4oC	14 days	9
		PCB - 680	7	1	0	1	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	0	1	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Herbicides-8151A	7	1	0	1	0				9
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2

Table 13 Undeveloped Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
5	Soil	VOC-5035/8260B	6	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	6	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B Mercury-7471A	6 6	1 1	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	8 8
		Cyanide-9010B	6	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB - 680	6	1	1	0	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A Herbicides-8151A	6 6	1 1	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8 8
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
6	Soil	VOC-5035/8260B	5	1	1	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	5	1	1	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B Mercury-7471A	5 5	1 1	1 1	1 1	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	8 8
		Cyanide-9010B	5	1	1	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB - 680	5	1	1	1	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A Herbicides-8151A	5 5	1 1	1 1	1 1	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8 8
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2

Table 13 Undeveloped Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
7	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B Mercury-7471A	7 7	1 1	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	9 9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB - 680	7	1	1	0	0	1-500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A Herbicides-8151A	7 7	1 1	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9 9
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
Total Samples			369	63	41	25	14				512

[1] or sample will be preserved in accordance with USEPA Method 5035

Table 14 Undeveloped Areas Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blank Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
1	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	1	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	9
		Mercury-7471A	7	1	1	0	0			28 days	9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB-680	7	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	1	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Herbicides-8151A	7	1	1	0	0				9
		Dioxin-8280	2	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
2	Soil	VOC-5035/8260B	6	1	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	6	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B	6	1	0	1	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	8
		Mercury-7471A	6	1	0	1	0			28 days	8
		Cyanide-9010B	6	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB-680	6	1	0	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A	6	1	0	1	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Herbicides-8151A	6	1	0	1	0				8
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2

Table 14 Undeveloped Areas Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blank Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number, size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
3	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	1	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	9
		Mercury-7471A	7	1	1	0	0			28 days	9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB-680	7	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	1	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Herbicides-8151A	7	1	1	0	0				9
		Dioxin-8280	1	1	1	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
4	Soil	VOC-5035/8260B	7	1	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B	7	1	0	1	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	9
		Mercury-7471A	7	1	0	1	0			28 days	9
		Cyanide-9010B	7	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB-680	7	1	0	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A	7	1	0	1	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Herbicides-8151A	7	1	0	1	0				9
		Dioxin-8280	1	1	0	1	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3

Table 14 Undeveloped Areas Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blank Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
5	Soil	VOC-5035/8260B	6	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	6	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B Mercury-7471A	6 6	1 1	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	8 8
		Cyanide-9010B	6	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB-680	6	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A Herbicides-8151A	6 6	1 1	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8 8
		Dioxin-8280	2	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
6	Soil	VOC-5035/8260B	5	1	1	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	10
		SVOC-8270C	5	1	1	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	8
		Metals-6010B Mercury-7471A	5 5	1 1	1 1	1 1	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	8 8
		Cyanide-9010B	5	1	1	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	8
		PCB-680	5	1	1	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8
		Pesticides-8081A Herbicides-8151A	5 5	1 1	1 1	1 1	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	8 8
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2

Table 14 Undeveloped Areas Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blank Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
7	Soil	VOC-5035/8260B	7	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	11
		SVOC-8270C	7	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	9
		Metals-6010B Mercury-7471A	7 7	1 1	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	9 9
		Cyanide-9010B	7	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	9
		PCB-680	7	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9
		Pesticides-8081A Herbicides-8151A	7 7	1 1	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	9 9
		Dioxin 8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
Total Samples			369	63	41	25	14				512

1---or sample will be preserved in accordance with USEPA method 5035

Table 15 Developed Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
1	Soil	VOC 5035/8260B	3	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	7
		SVOC-8270C	3	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	5
		Metals-6010B Mercury-7471A	3 3	1 1	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	5 5
		Cyanide-9010B	3	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	5
		PCB - 680	3	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5
		Pesticides-8081A Herbicides-8151A	3 3	1 1	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5 5
		Dioxin-8280	1	1	1	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
2	Soil	VOC-5035/8260B	3	0	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	6
		SVOC-8270C	3	0	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	4
		Metals-6010B Mercury-7471A	3 3	0 0	0 0	1 1	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	4 4
		Cyanide-9010B	3	0	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	4
		PCB - 680	3	0	0	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4
		Pesticides-8081A Herbicides-8151A	3 3	0 0	0 0	1 1	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4 4
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0

Table 15 Developed Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
3	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B Mercury-7471A	3 3	0 0	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	3 3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB - 680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A Herbicides-8151A	3 3	0 0	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3 3
		Dioxin-8280	1	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	1
4	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B Mercury-7471A	3 3	0 0	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	3 3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB - 680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A Herbicides-8151A	3 3	0 0	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3 3
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0

Table 15 Developed Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
5	Soil	VOC-5035/8260B	3	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	7
		SVOC-8270C	3	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	5
		Metals-6010B	3	1	1	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	5
		Mercury-7471A	3	1	1	0	0			28 days	5
		Cyanide-9010B	3	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	5
		PCB - 680	3	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5
		Pesticides-8081A	3	1	1	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5
		Herbicides-8151A	3	1	1	0	0				5
		Dioxin-8280	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
6	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B	3	0	0	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	3
		Mercury-7471A	3	0	0	0	0			28 days	3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB - 680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A	3	0	0	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Herbicides-8151A	3	0	0	0	0				3
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0

Table 15 Developed Area Surface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
7	Soil	VOC-5035/8260B	2	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	4
		SVOC-8270C	2	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	2
		Metals-6010B	2	0	0	0	0	1 - 4 oz widemouth	4°C	180 days	2
		Mercury-7471A	2	0	0	0	0	poly or fluorocarbon		28 days	2
		Cyanide-9010B	2	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	2
		PCB - 680	2	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2
		Pesticides-8081A	2	0	0	0	0	1 - 250 ml widemouth	4°C	14/40 days	2
		Herbicides-8151A	2	0	0	0	0	glass w/Teflon lined lid			2
		Dioxin-8280	1	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	1
Total Samples			164	18	17	8	14				221

[1] or sample will be preserved in accordance with USEPA Method 5035

Table 16 Developed Area Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
1	Soil	VOC-5035/8260B	3	0	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	6
		SVOC-8270C	3	0	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	4
		Metals-6010B	3	0	1	0	0	1 - 4 oz widemouth	4°C	180 days	4
		Mercury-7471A	3	0	1	0	0	poly or fluorocarbon		28 days	4
		Cyanide-9010B	3	0	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	4
		PCB-680	3	0	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4
		Pesticides-8081A	3	0	1	0	0	1 - 250 ml widemouth	4°C	14/40 days	4
		Herbicides-8151A	3	0	1	0	0	glass w/Teflon lined lid			4
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0
2	Soil	VOC-5035/8260B	3	1	0	1	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	7
		SVOC-8270C	3	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	5
		Metals-6010B	3	1	0	1	0	1 - 4 oz widemouth	4°C	180 days	5
		Mercury-7471A	3	1	0	1	0	poly or fluorocarbon		28 days	5
		Cyanide-9010B	3	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	5
		PCB-680	3	1	0	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5
		Pesticides-8081A	3	1	0	1	0	1 - 250 ml widemouth	4°C	14/40 days	5
		Herbicides-8151A	3	1	0	1	0	glass w/Teflon lined lid			5
		Dioxin-8280	1	1	0	1	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3

Table 16 Developed Area Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
3	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B Mercury-7471A	3 3	0 0	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	3 3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB-680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A Herbicides-8151A	3 3	0 0	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3 3
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0
4	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B Mercury-7471A	3 3	0 0	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	3 3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB-680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A Herbicides-8151A	3 3	0 0	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3 3
		Dioxin-8280	1	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	1

Table 16 Developed Area Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
5	Soil	VOC-5035/8260B	3	1	1	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	7
		SVOC-8270C	3	1	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	5
		Metals-6010B	3	1	1	0	0	1 - 4 oz widemouth	4°C	180 days	5
		Mercury-7471A	3	1	1	0	0	poly or fluorocarbon		28 days	5
		Cyanide-9010B	3	1	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	5
		PCB-680	3	1	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	5
		Pesticides-8081A	3	1	1	0	0	1 - 250 ml widemouth	4°C	14/40 days	5
		Herbicides-8151A	3	1	1	0	0	glass w/Teflon lined lid			5
		Dioxin-8280	0	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	0
6	Soil	VOC-5035/8260B	3	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	3	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B	3	0	0	0	0	1 - 4 oz widemouth	4°C	180 days	3
		Mercury-7471A	3	0	0	0	0	poly or fluorocarbon		28 days	3
		Cyanide-9010B	3	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB-680	3	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A	3	0	0	0	0	1 - 250 ml widemouth	4°C	14/40 days	3
		Herbicides-8151A	3	0	0	0	0	glass w/Teflon lined lid			3
		Dioxin-8280	1	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	1

Table 16 Developed Area Subsurface Soil Sampling - Sample and Analysis Summary

Transect	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
7	Soil	VOC-5035/8260B	2	0	0	0	2	3- 5 gm Encore[1]	4°C	48 hours/14 days	4
		SVOC-8270C	2	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	2
		Metals-6010B	2	0	0	0	0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	2
		Mercury-7471A	2	0	0	0	0			28 days	2
		Cyanide-9010B	2	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	2
		PCB-680	2	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2
		Pesticides-8081A	2	0	0	0	0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2
		Herbicides-8151A	2	0	0	0	0				2
		Dioxin-8280	1	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	1
Total Samples			164	17	16	9	14				220

[1] or sample will be preserved in accordance with USEPA Method 5035

Table 17 Background Soil Samples - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
EE-04	Soil	VOC-5035/8260B	2	0	1	0	1	3- 5 gm Encore[1]	4°C	48 hours/14 days	4
		SVOC-8270C	2	0	1	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	3
		Metals-6010B Mercury-7471A	2 2	0 0	1 1	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	3 3
		Cyanide-9010B	2	0	1	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	3
		PCB-680	2	0	1	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3
		Pesticides-8081A Herbicides-8151A	2 2	0 0	1 1	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	3 3
		Dioxin-8280	2	0	1	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	3
EE-20	Soil	VOC-5035/8260B	2	1	0	1	0	3- 5 gm Encore[1]	4°C	48 hours/14 days	4
		SVOC-8270C	2	1	0	1	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	4
		Metals-6010B Mercury-7471A	2 2	1 1	0 0	1 1	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	4 4
		Cyanide-9010B	2	1	0	1	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	4
		PCB-680	2	1	0	1	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4
		Pesticides-8081A Herbicides-8151A	2 2	1 1	0 0	1 1	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4 4
		Dioxin-8280	2	1	0	1	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	4

Table 17 Background Soil Samples - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
EE-108	Soil	VOC-5035/8260B	2	0	0	0	1	3- 5 gm Encore[1]	4°C	48 hours/14 days	3
		SVOC 8270C	2	0	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	2
		Metals-6010B Mercury-7471A	2 2	0 0	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	2 2
		Cyanide-9010B	2	0	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	2
		PCB-680	2	0	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2
		Pesticides-8081A Herbicides-8151A	2 2	0 0	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2 2
		Dioxin-8280	2	0	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
Total Samples			54	9	9	9	2				83

[1] ---or sample will be preserved in accordance with USEPA method 5035

Table 18 Undeveloped Area Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Dead Creek Segment B & F	Sediment	PCB-680	50	10	5	3	0	1 - 500 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	68
		TPH-8015B	50	10	5	3	0	2 - 4 oz widemouth glass w/Teflon lined lid	4°C	14/40 days	68
		Copper-7211	50	10	5	3	0	1 - 4oz wide mouth	4°C	180 days	68
		Zinc-7951	50	10	5	3	0	poly or fluorocarbon			68
		TOC-9060	50	10	5	3	0	1 - 4oz wide mouth glass w/Teflon lined lid	4°C	28 days	68
		Grain Size	50	10	0	0	0				60
		Solids Content-SM-2540G	50	10	5	3	0				68
Total Samples			350	70	30	18	0				468

Table 19 Developed Area Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Dead Creek Segments C,D, & E	Sediment	PCB-680	47	10	5	3	0	1 - 500 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	65
		TPH-8015B	47	10	5	3	0	2 - 4 oz widemouth glass w/Teflon lined lid	4°C	14/40 days	65
		Copper-7211 Zinc-7951	47 47	10 10	5 5	3 3	0 0	1 - 4oz wide mouth poly or fluorocarbon	4°C	180 days	65 65
		TOC-9060	47	10	5	3	0	1 - 4oz wide mouth glass w/Teflon lined lid	4°C	28 days	65
		Grain Size	47	10	0	0	0				57
		Solids Content-SM-2540G	47	10	5	3	0				65
Total Samples			329	70	30	18	10				447

Table 20 Borrow Pit Lake Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Borrow Pit Lake	Sediment	PCB-680	8	2	1	1	0	1 - 500 ml wide mouth glass w/Teflon lined lid	4°C	14/40 days	12
		TPH-8015B	8	2	1	1	0	2 - 4 oz widemouth glass w/Teflon lined lid	4°C	14/40 days	12
		Copper-7211	8	2	1	1	0	1 - 4oz wide mouth	4°C	180 days	12
		Zinc-7951	8	2	1	1	0	poly or fluorocarbon			12
		TOC-9060	8	2	1	1	0	1 - 4oz wide mouth glass w/Teflon lined lid	4°C	28 days	12
		Grain Size	8	2	0	0	0				10
		Solids Content-SM-2540G	8	2	1	1	0				12
Total Samples			56	14	6	6	0				82

Table 21 Dead Creek Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Dead Creek Segments B through F	Sediment	VOC-5035/8260B	18	3	1	1	5	3- 5 gm Encore[1]	4°C	48 hours/14 days	28
		SVOC-8270C	18	3	1	1		1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	23
		Metals-6010B	18	3	1	1		1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days	23
		Mercury-7471A	18	3	1	1				28 days	23
		Cyanide-9010B	18	3	1	1		1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	23
		PCB-680	18	3	1	1		1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	23
		Pesticides-8081A	18	3	1	1		1 - 250 ml widemouth glass w/Teflon lined lid	4°C		23
		Herbicides-8151A	18	3	1	1					23
		Dioxin-8290	18	3	1	1		100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	23
		TOC-9060	18	3	1	0	0	1 - 4oz wide mouth glass w/Teflon lined lid	4°C	28 days	23
		Grain Size	18	0	0	0	0				18
		Solids Content-SM-2540G	18	0	1	0	0				18

Table 21 Dead Creek Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Borrow Pit Lake	Sediment	VOC-5035/8260B	2	1	1	0	1	3- 5 gm Encore[1]	4°C	48 hours/14 days	5
		SVOC-8270C	2	1	1	0		1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	4
		Metals-6010B Mercury-7471A	2 2	1 1	1 1	0 0		1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	4 4
		Cyanide-9010B	2	1	1	0		1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	4
		PCB-680	2	1	1	0		1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	4
		Pesticides-8081A Herbicides-8151A	2 2	1 1	1 1	0 0		1 - 250 ml widemouth glass w/Teflon lined lid	4°C		4 4
		Dioxin-8290	2	1	1	0		100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	4
		TOC-9060	2	1	1	0	0	1 - 4oz wide mouth glass w/Teflon lined lid	4°C	28 days	4
		Grain Size	2	0	0	0	0				2
		Solids Content-SM-2540G	2	0	1	0	0				3
Total Samples			240	40	22	12	6				320

[1] or sample will be preserved in accordance with USEPA Method 5035

Table 22 Dead Creek Ecological Sediment Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Site M	Sediment	VOC-5035/8260B	1	1	0	0	0	3- 5 gm Encore[1]	4°C	48 hours	2
		SVOC-8270C	1	1	0	0	0	1-250 ml widemouth glass with Teflon lined lid	4°C	14/40 days	2
		Metals-6010B Mercury-7471A	1 1	1 1	0 0	0 0	0 0	1 - 4 oz widemouth poly or fluorocarbon	4°C	180 days 28 days	2 2
		Cyanide-9010B	1	1	0	0	0	1 - 4 oz widemouth glass w/Teflon lined lid	4°C	14 days	2
		PCB-680	1	1	0	0	0	1 - 500 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2
		Pesticides-8081A Herbicides-8151A	1 1	1 1	0 0	0 0	0 0	1 - 250 ml widemouth glass w/Teflon lined lid	4°C	14/40 days	2 2
		Dioxin-8290	1	1	0	0	0	100 gm in 1-4 oz amber glass jar w/Teflon lined lid	4°C	30/45 days	2
Total Samples			207	63	27	18	8				323

1 or sample will be preserved in accordance with USEPA Method5035

Table 23 Surface Water Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmenta Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Dead Creek Segment B through Segment F	Water	VOC-8260B	18	4	1	1	10	3-40 ml glass vials w/Teflon lined septum caps	HCL to pH<2 4°C	14 days	34
		SVOC-8270C	18	4	1	1	0	2-1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	24
		Metals-6010A Mercury-7470A	18 18	4 4	1 1	1 1		1-250 or 500 ml poly or fluorocarbon	HNO_3 to pH<2 4°C	180 days 28 days	24 24
		Cyanide-9010B	18	4	1	1	0	1-250 or 500 ml poly	NaOH to pH >12, 4°C	14 days	24
		PCB--680	18	4	1	1	0	4 - 1 liter amber glass w/Teflon lined screw cap	4°C	7/40 days	24
		Pesticides-8081A Herbicides-8151A	18 18	4 4	1 1	1 1	0 0	4 - 1 liter amber glass w/Teflon lined screw cap	4°C	7/40 days	24 24
		Dioxin-8290	18	4	1	1	0	2-1 liter amber glass w/Teflon lined screw caps	4°C	30/45	24
		TSS-160.2	18	4	1	1	0	1 - 250 or 500 ml poly	4°C	7 days	24
		TDS-160.1	18	4	1	1	0	1-250 or 500 ml poly	4°C	7 days	24
		Hardness-130.1/130.2	18	4	1	1	0	1-250 ml poly or fluorocarbon	4°C $HNO_3$to pH<2	6 months	24
		pH-150.1/150.2	18	4	1	1	0	1 - 100ml poly	4°C	As soon as possible	24
		Fluoride-300.0	18	4	1	1	0	1-250 or 500 ml plastic bottle	4°C	28 days	24
		Total Phosphorus -365.4	18	4	1	1	0	1- 1 liter plastic bottle	2 ml H_2SO_4 4°C	28 days	24
		Orthophosphate -300.0	18	4	1	1	0	1- 1 liter plastic bottle	2 ml H_2SO_4 4°C	48 hours	24

Table 23 Surface Water Sampling - Sample and Analysis Summary

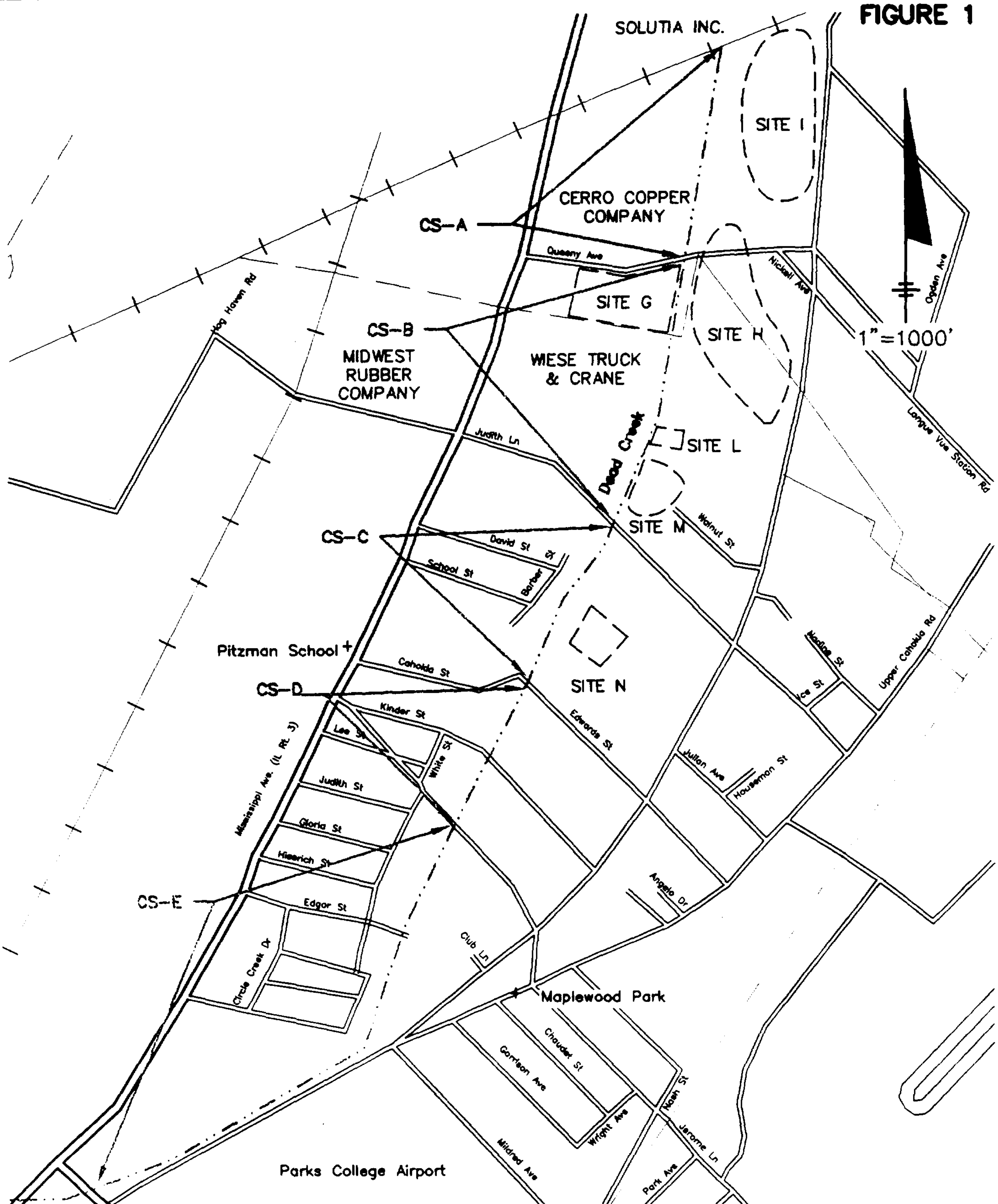
Station	Matrix	Parameters	Number of Environmenta Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
Borrow Pit Lake	Water	VOC-8260B	2	0	1	0	0	3-40 ml glass vials w/Teflon lined septum caps	HCL to pH<2 4°C	14 days	3
		SVOC-8270C	2	0	1	0	0	2-1 liter amber glass w/Teflon lined screw caps	4°C	7/40 days	3
		Metals-6010A Mercury-7470A	2 2	0 0	1 1	0 0		1-250 or 500 ml poly or fluorocarbon	HNO_3 to pH<2 4°C	180 days 28 days	3 3
		Cyanide-9010B	2	0	1	0	0	1-250 or 500 ml poly	NaOH to pH >12, 4°C	14 days	3
		PCB--680	2	0	1	0	0	4 - 1 liter amber glass w/Teflon lined screw cap	4°C	7/40 days	3
		Pesticides-8081A Herbicides-8151A	2 2	0 0	1 1	0 0	0 0	4 - 1 liter amber glass w/Teflon lined screw cap	4°C	7/40 days	3 3
		Dioxin-8290	2	0	1	0	0	2-1 liter amber glass w/Teflon lined screw caps	4°C	30/45	3
		TSS-160.2	2	0	1	0	0	1 - 250 or 500 ml poly	4°C	7 days	3
		TDS-160.1	2	0	1	0	0	1-250 or 500 ml poly	4°C	7 days	3
		Hardness-130.1/130.2	2	0	1	0	0	1-250 ml poly or fluorocarbon	4°C $HNO_3$to pH<2	6 months	3
		pH-150.1/150.2	2	0	1	0	0	1 - 100ml poly	4°C	As soon as possible	3
		Fluoride-300.0	2	0	1	0	0	1-250 or 500 ml plastic bottle	4°C	28 days	3
		Total Phosphorus -365.4	2	0	1	0	0	1- 1 liter plastic bottle	2 ml H_2SO_4 4°C	28 days	3
		Orthophosphate -300.0	2	0	1	0	0	1- 1 liter plastic bottle	2 ml H_2SO_4 4°C	48 hours	3
Total Samples			320	64	32	16	10				442

Table 24 Air Sampling - Sample and Analysis Summary

Station	Matrix	Parameters	Number of Environmental Samples	Number of Field Blanks/ Equipment Blanks	Number of Field Duplicates	Number of Matrix Spike/Matrix Spike Duplicates or Spike Duplicates	Number of Trip Blanks	Sample Containers (number,size, type)	Preservation	Holding Time extraction/analysis	Total Analyses
G	Air	VOC - TO-1	4	1	0	0	1	1- Sorbent Tube	4°C	7 days	6
		SVOC-TO13	4	1	0	0	0	PUF	4°C	7 days	5
		PCB-TO-4	4	1	0	0	0	PUF	4°C	7 days	5
		Dioxins-TO-9	4	1	0	0	0	PUF	4°C	7 days	5
		Metals-6010B	4	1	0	0	0	PM 2.5	4°C	7 days	5
H,I,L	Air	VOC - TO-1	9	0	0	0	2	1- Sorbent Tube	4°C	7 days	11
		SVOC-TO13	9	0	0	0	0	PUF	0°C	7 days	9
		PCB-TO-4	9	0	0	0	0	PUF	4°C	7 days	9
		Dioxins-TO-9	9	0	0	0	0	PUF	4°C	7 days	9
		Metals-6010B	9	0	0	0	0	PM 2.5	4°C	7 days	9
Total Samples			65	5	0	0	3				73

FIGURES

FIGURE 1



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET & CAHOKIA, IL

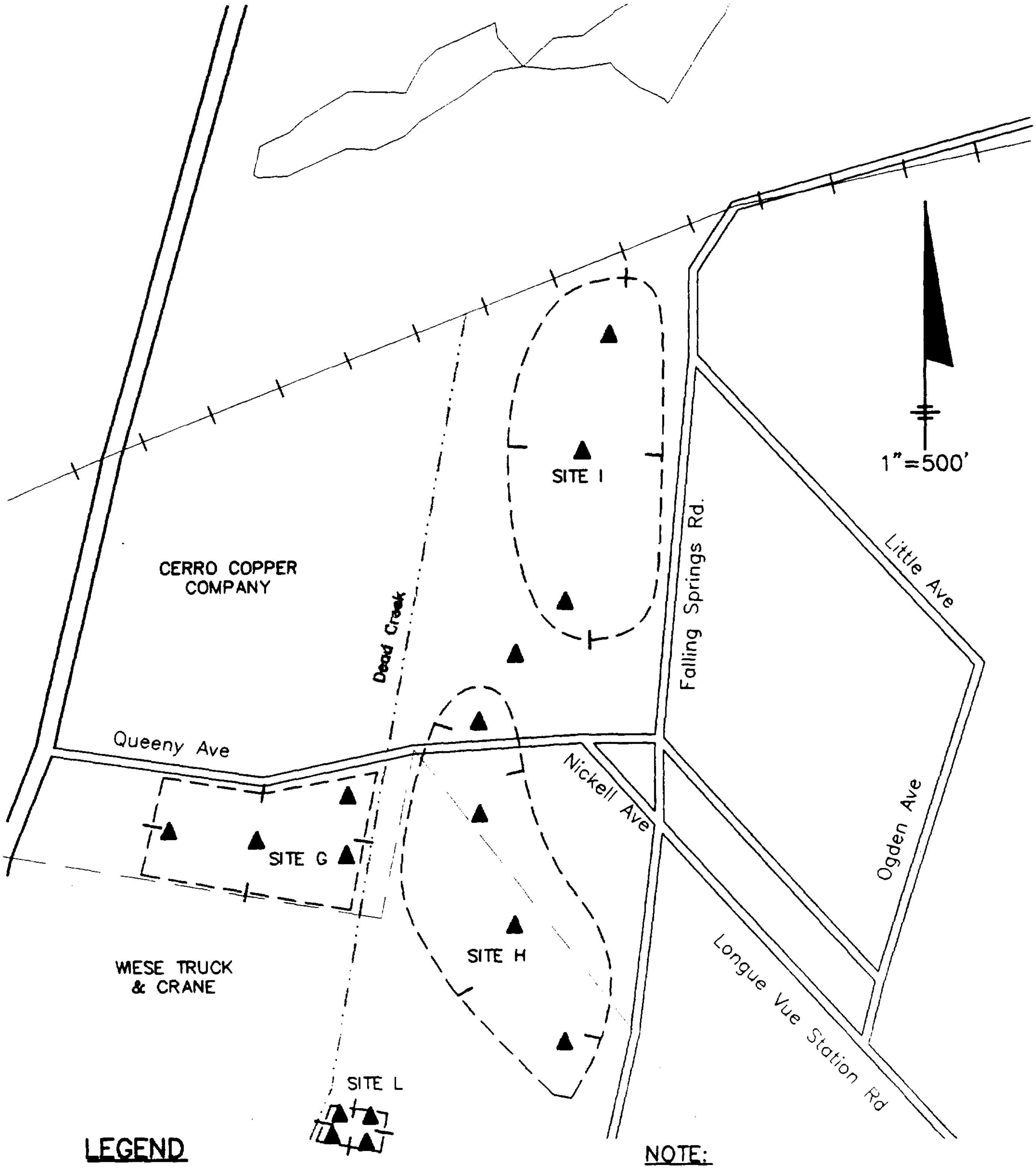
FILL AREA & CREEK SECTOR LOCATION MAP

23548.010.05
3/29/99

PLOT DATE:

O'BRIEN & GERE ENGINEERS INC.

FIGURE 2



LEGEND

— BOUNDARY CONFIRMATION TRENCH

▲ WASTE CHARACTERIZATION BORING

NOTE:

1. TRENCH AND BORING LOCATIONS WILL BE FINALIZED AFTER COMPLETING AIR PHOTO ANALYSIS OF THE FILL AREAS.

SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET & CAHOKIA, IL

PRELIMINARY BOUNDARY CONFIRMATION TRENCH & WASTE CHARACTERIZATION BORING LOCATIONS AT SITES G, H, I & L

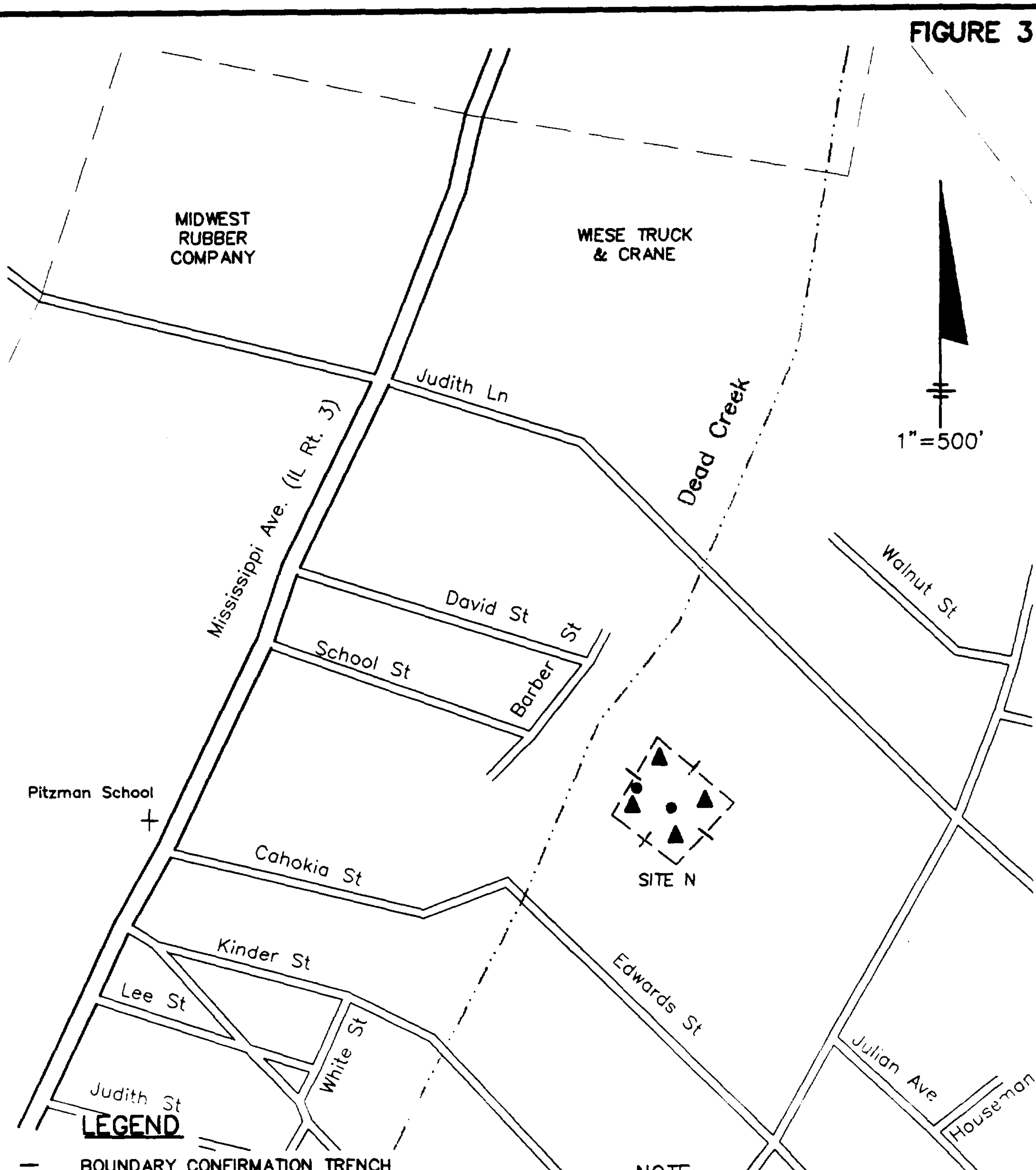
23548.010.06
3/29/99

PLOT DATE:

O'BRIEN & GERE ENGINEERS INC.

DWG PATH: I:\PROJECTS\10040\23548\Dh... .DWG 1-500

FIGURE 3



LEGEND

— BOUNDARY CONFIRMATION TRENCH

▲ WASTE CHARACTERIZATION BORING

● SUBSURFACE SOIL SAMPLE LOCATION

NOTE:

1. TRENCH AND BORING LOCATIONS WILL BE FINALIZED AFTER COMPLETING AIR PHOTO ANALYSIS OF THE FILL AREAS.

SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

PRELIMINARY BOUNDARY CONFIRMATION TRENCH & WASTE CHARACTERIZATION BORING LOCATIONS AT SITE N

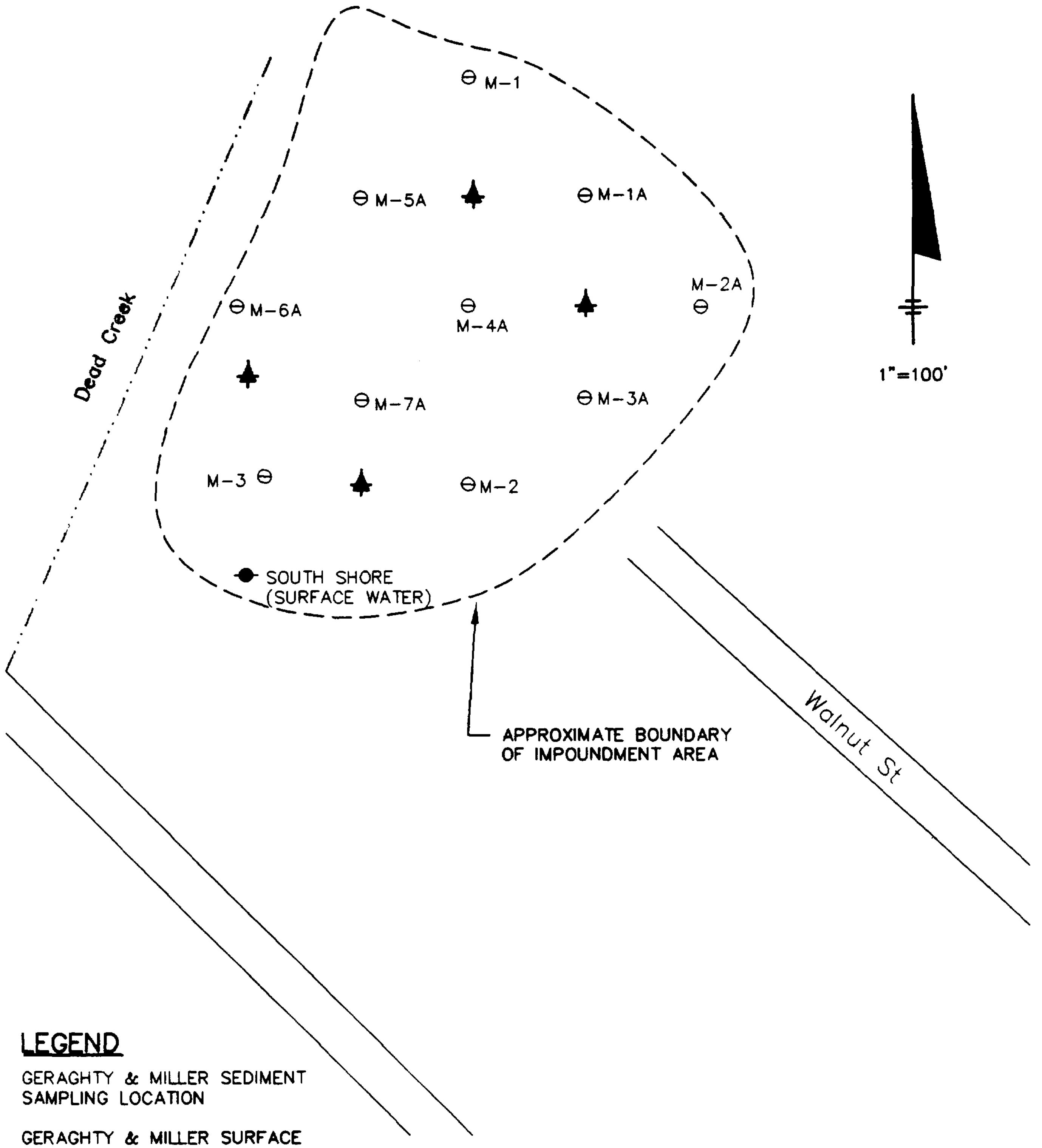
23548.010.07
3/30/99

O'BRIEN & GERE ENGINEERS INC.

PLOT DATE: 4/...

DWG PATH: I:\PROJECTS\10040\23548\ .DWG 1=200

FIGURE 4



LEGEND

⊖ GERAGHTY & MILLER SEDIMENT SAMPLING LOCATION

● GERAGHTY & MILLER SURFACE WATER SAMPLING LOCATION

▲ SSP WASTE CHARACTERIZATION SAMPLING LOCATION

SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

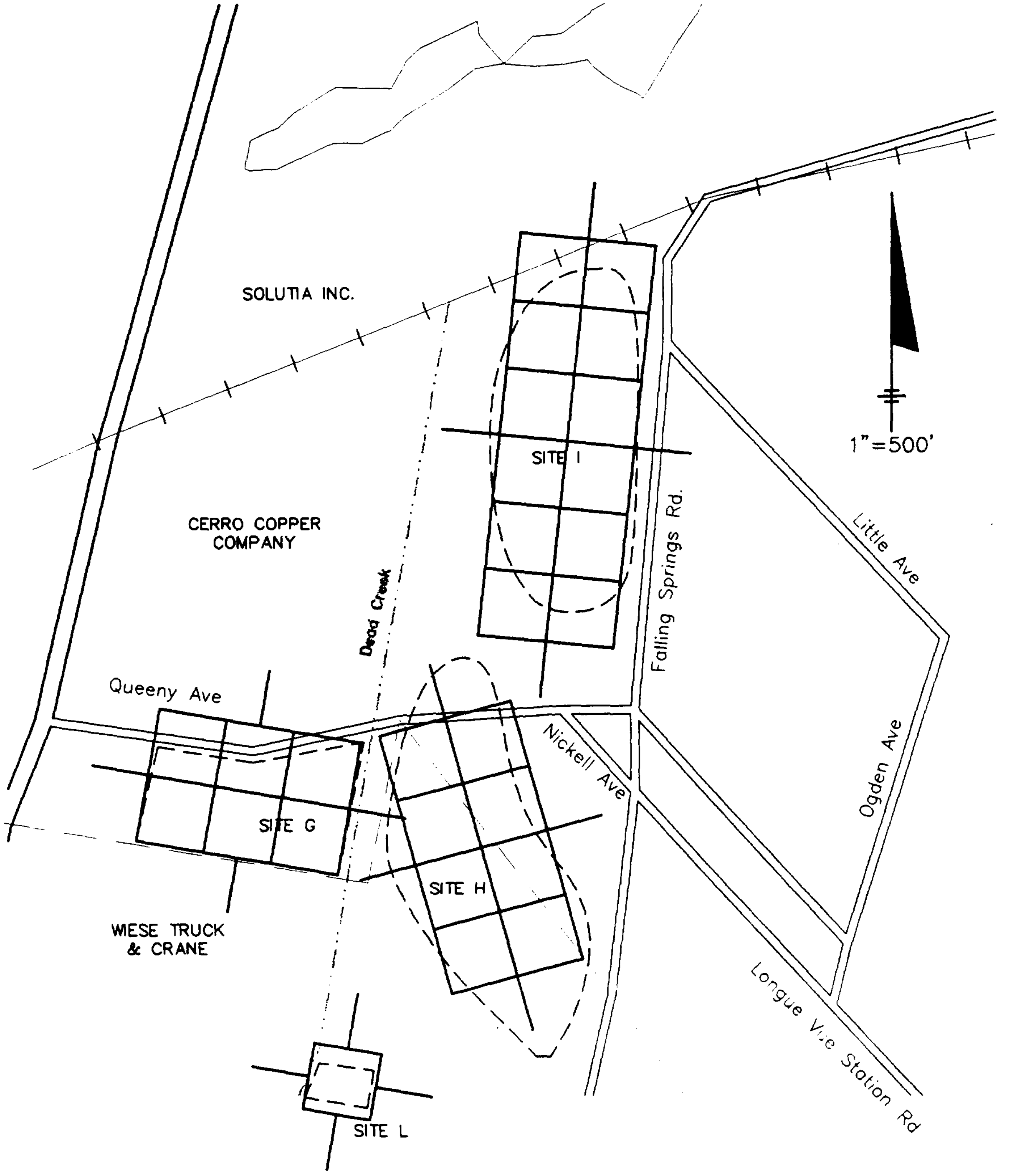
PRELIMINARY WASTE CHARACTERIZATION SAMPLING LOCATIONS AT SITE M

23548.010.08
3/30/99

PLOT DATE:

O'BRIEN & GERE ENGINEERS INC.

FIGURE 5



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET & CAHOKIA, IL

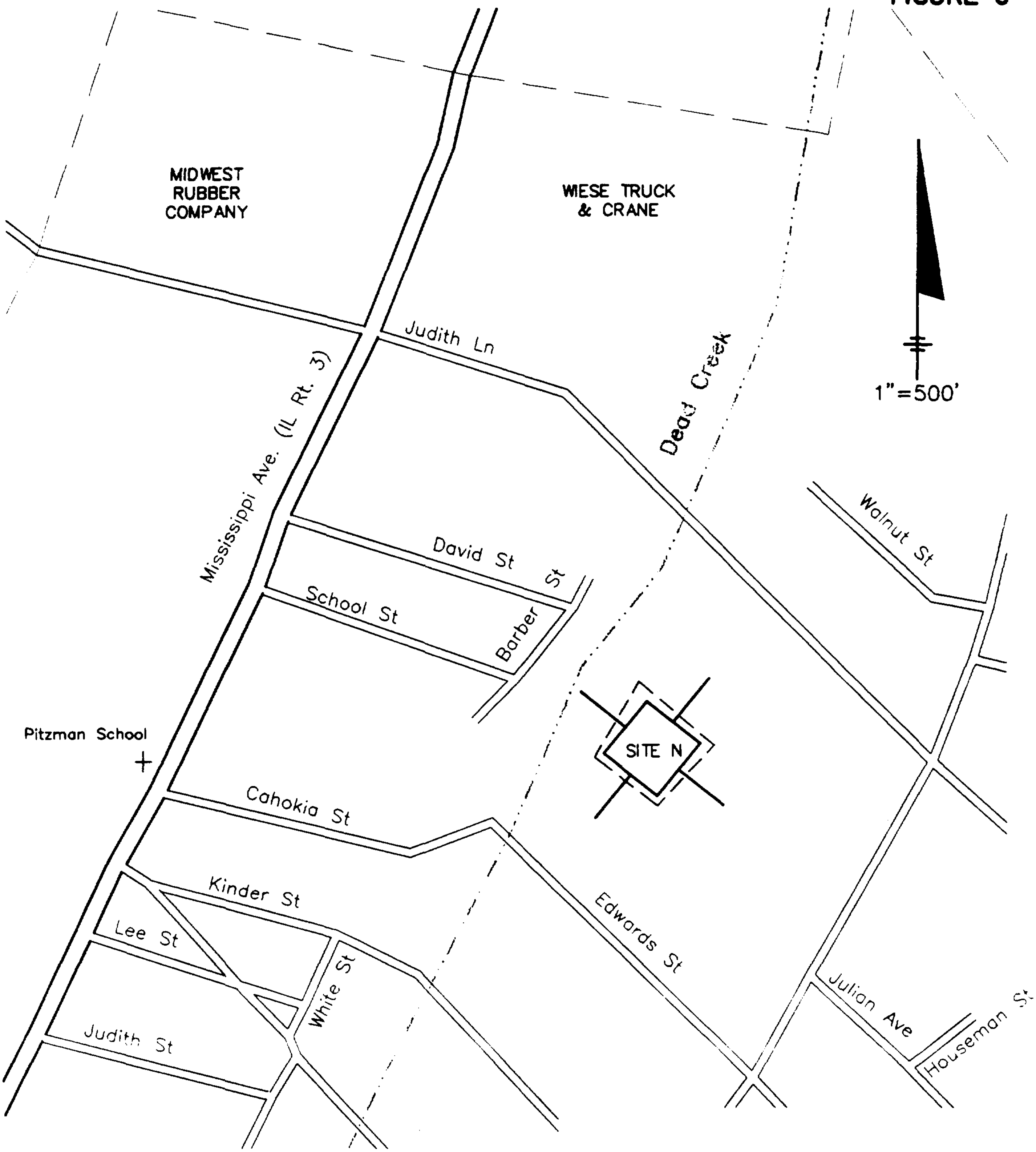
SOIL GAS SURVEY SAMPLING GRID
AT SITES G, H, I & L

23548.010.09
3/30/99

O'BRIEN & GERE ENGINEERS INC.

PLOT DATE:

FIGURE 6



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

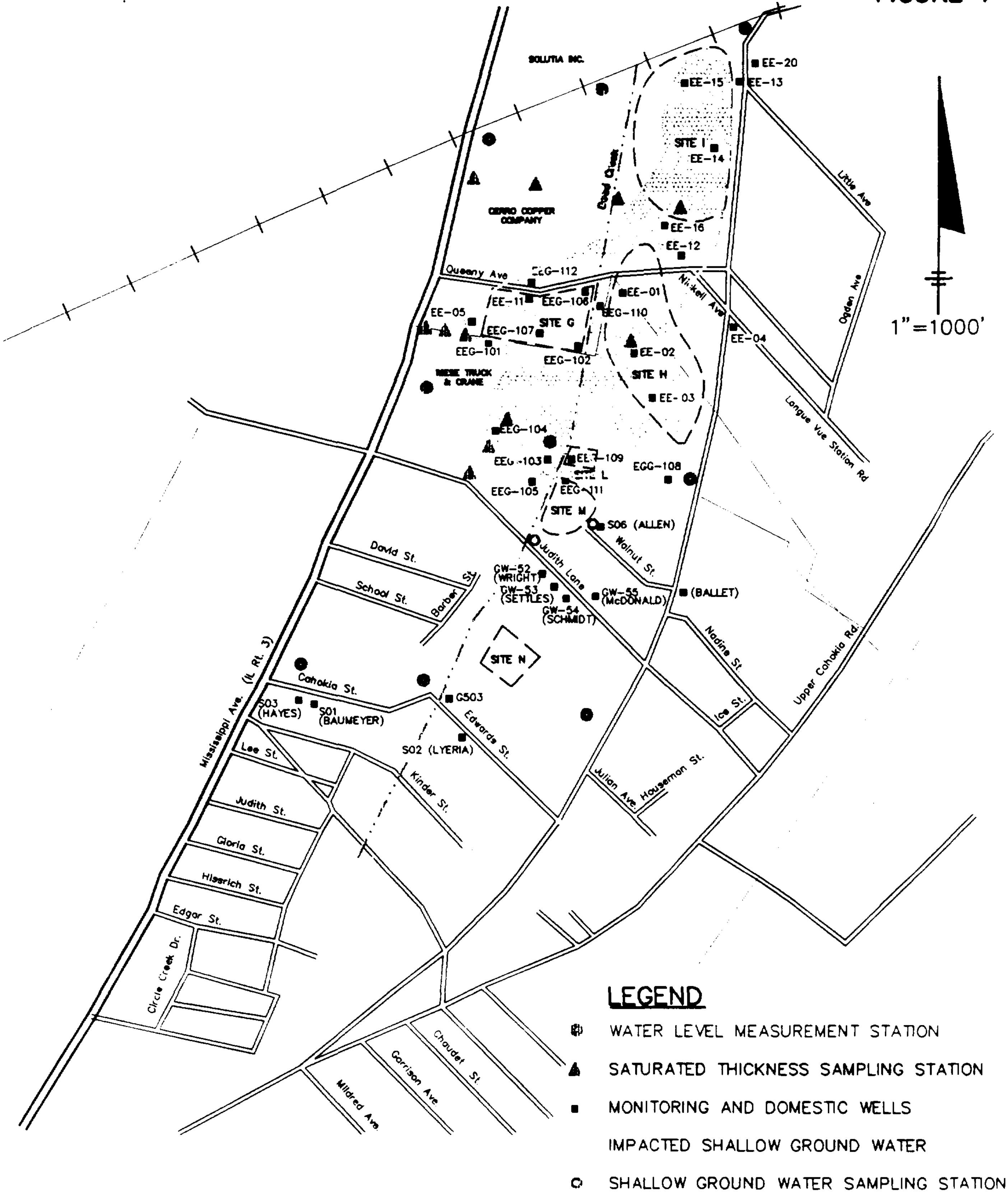
SOIL GAS SURVEY SAMPLING GRID AT SITE N

23548.010.10
3/30/99

O'BRIEN & GERE ENGINEERS INC.

DWG PATH: I:\PROJECTS\10040\23548\... .DWG 1=500
PLOT DATE:

FIGURE 7



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET & CAHOKIA, IL

GROUND WATER SAMPLING LOCATIONS

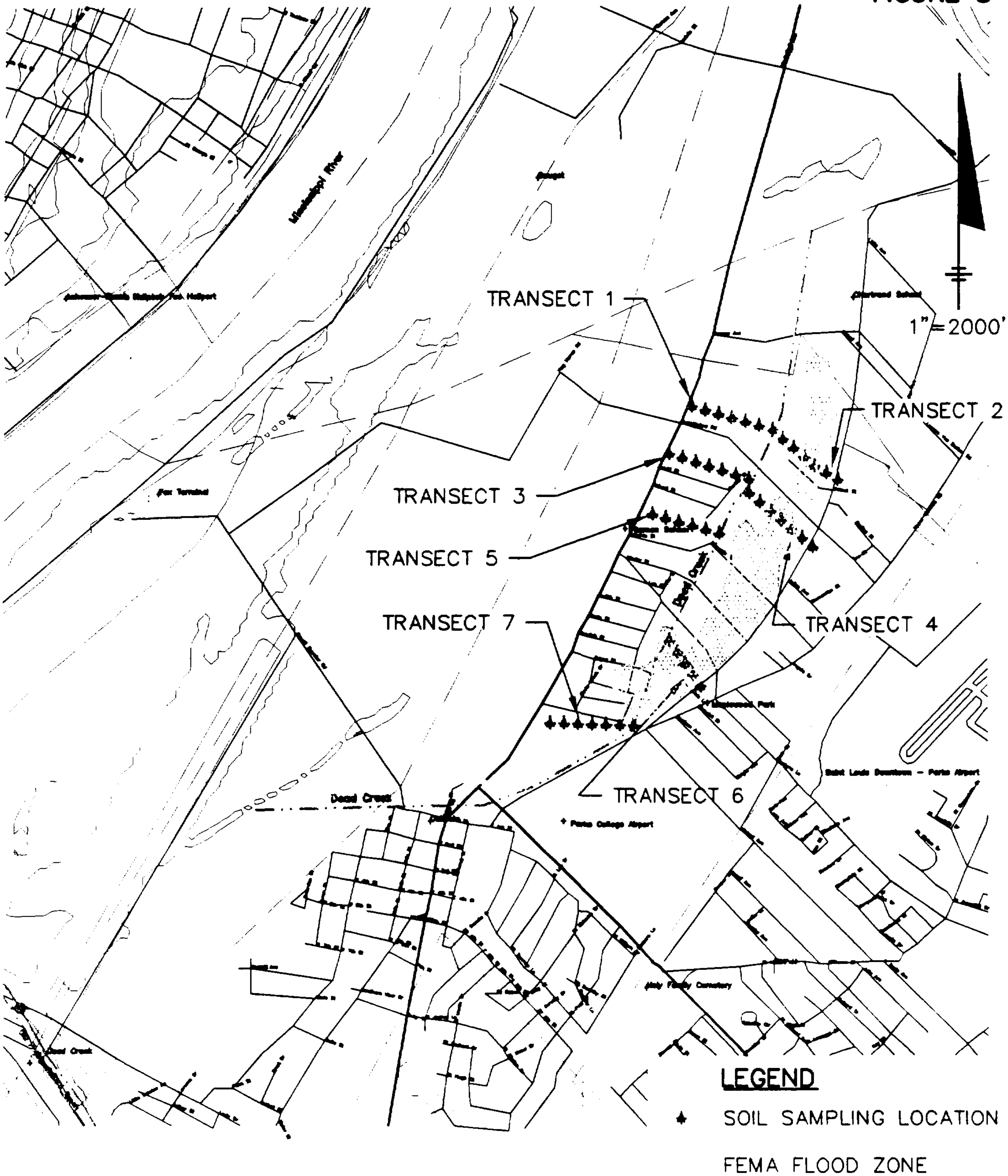
23548.010.11
3/30/99

O'BRIEN & GERE ENGINEERS INC.

PLOT DATE:

DWG PATH: I:\10040\23548\DWG : 1=2000

FIGURE 8



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

SOIL SAMPLING LOCATIONS

23548.010.04
3/29/99

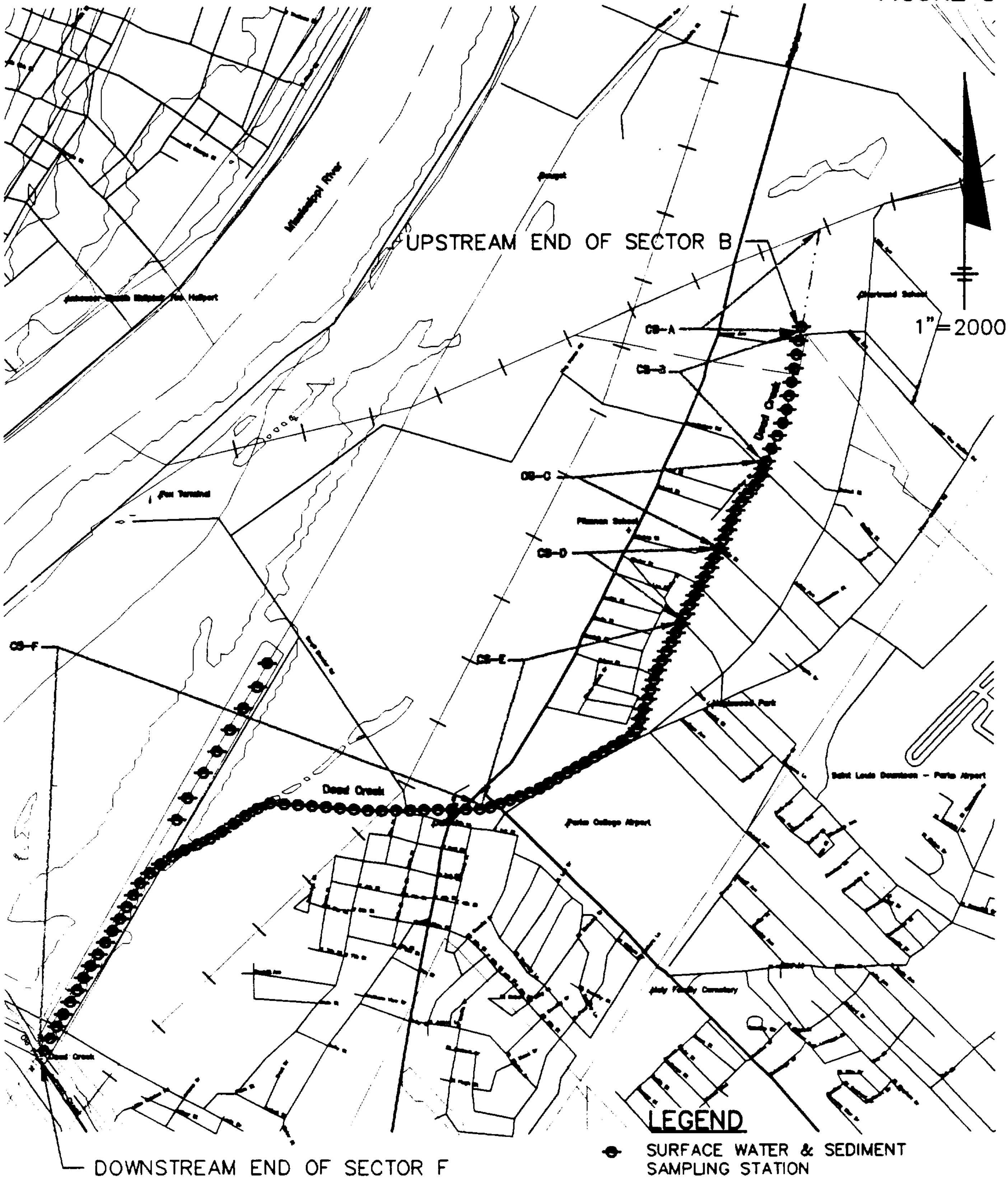
O'BRIEN & GERE ENGINEERS INC.

PLOT DATE: 4/

DWG PATH: I:\10040\23548\

PLOT DATE:

FIGURE 9



SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

SURFACE WATER & SEDIMENT SAMPLING LOCATIONS
INDUSTRY-SPECIFIC
CONSTITUENT MIGRATION

23548.010.03
3/29/99

O'BRIEN & GERE ENGINEERS INC.

DWG PATH: I:\10040\23548\L 2DWG 1=2000

FIGURE 10

LEGEND

SURFACE WATER & SEDIMENT SAMPLING STATION

SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

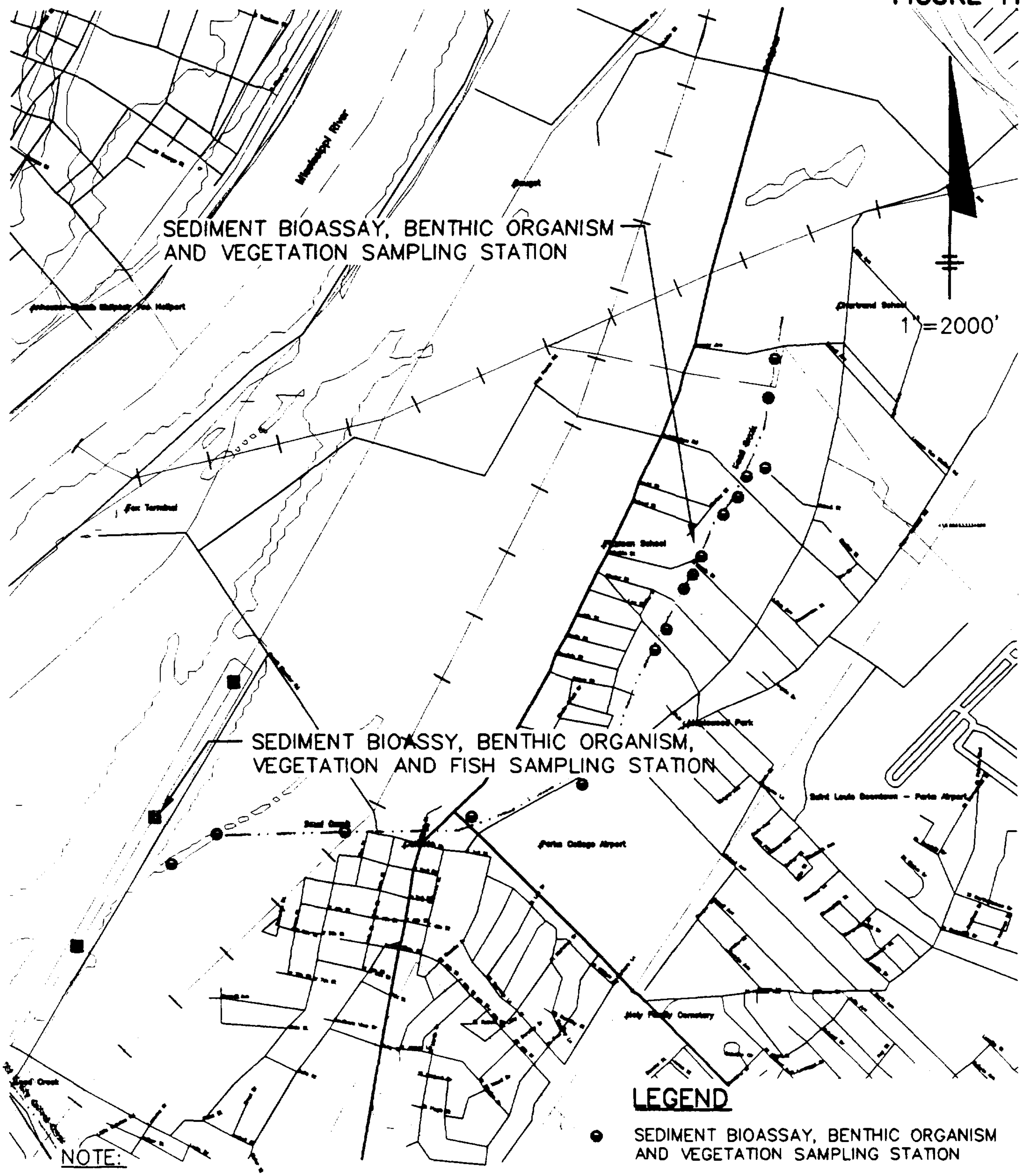
SURFACE WATER & SEDIMENT SAMPLING LOCATIONS
SITE-SPECIFIC CONSTITUENT MIGRATION

23548.010.02
3/29/99

O'BRIEN & GERE ENGINEERS INC.

PLOT DATE: ,99

FIGURE 11



NOTE:
REFERENCE AREA 1 AND 2 NOT SHOWN ON FIGURE.

LEGEND

● SEDIMENT BIOASSAY, BENTHIC ORGANISM AND VEGETATION SAMPLING STATION

■ SEDIMENT BIOASSY, BENTHIC ORGANISM, VEGETATION AND FISH SAMPLING STATION

SAUGET AREA 1 SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

ECOLOGICAL SAMPLING LOCATIONS

23548.010.01
3/29/99

O'BRIEN & GERE ENGINEERS INC.

DWG PATH: I:\10040\23548\ DWG 1=2000

PLOT DATE: 9